Automotive Service Digest

Our 46th year

September, 1958

Small cars in the service picture—See Page 24

Since 1903

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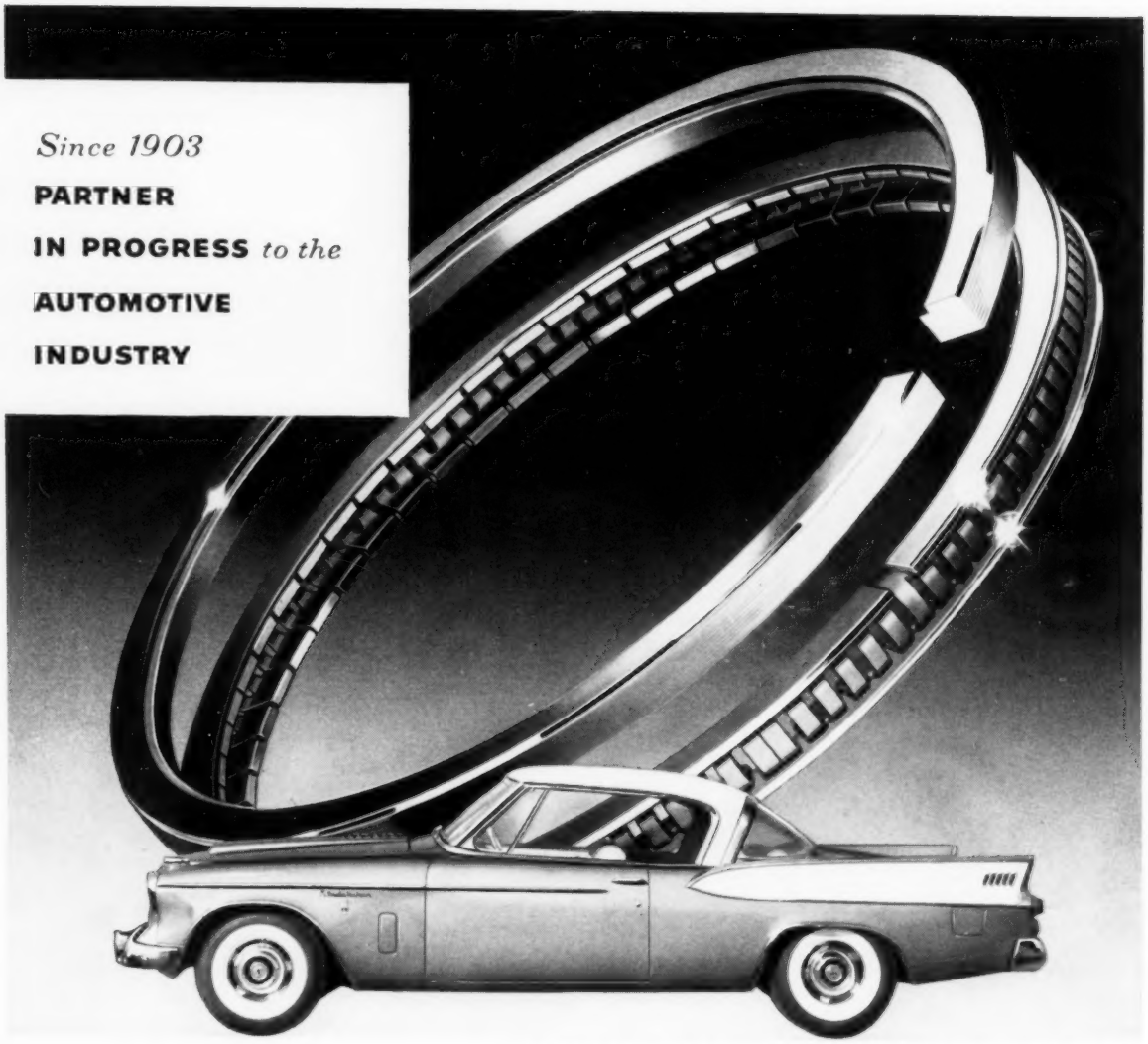

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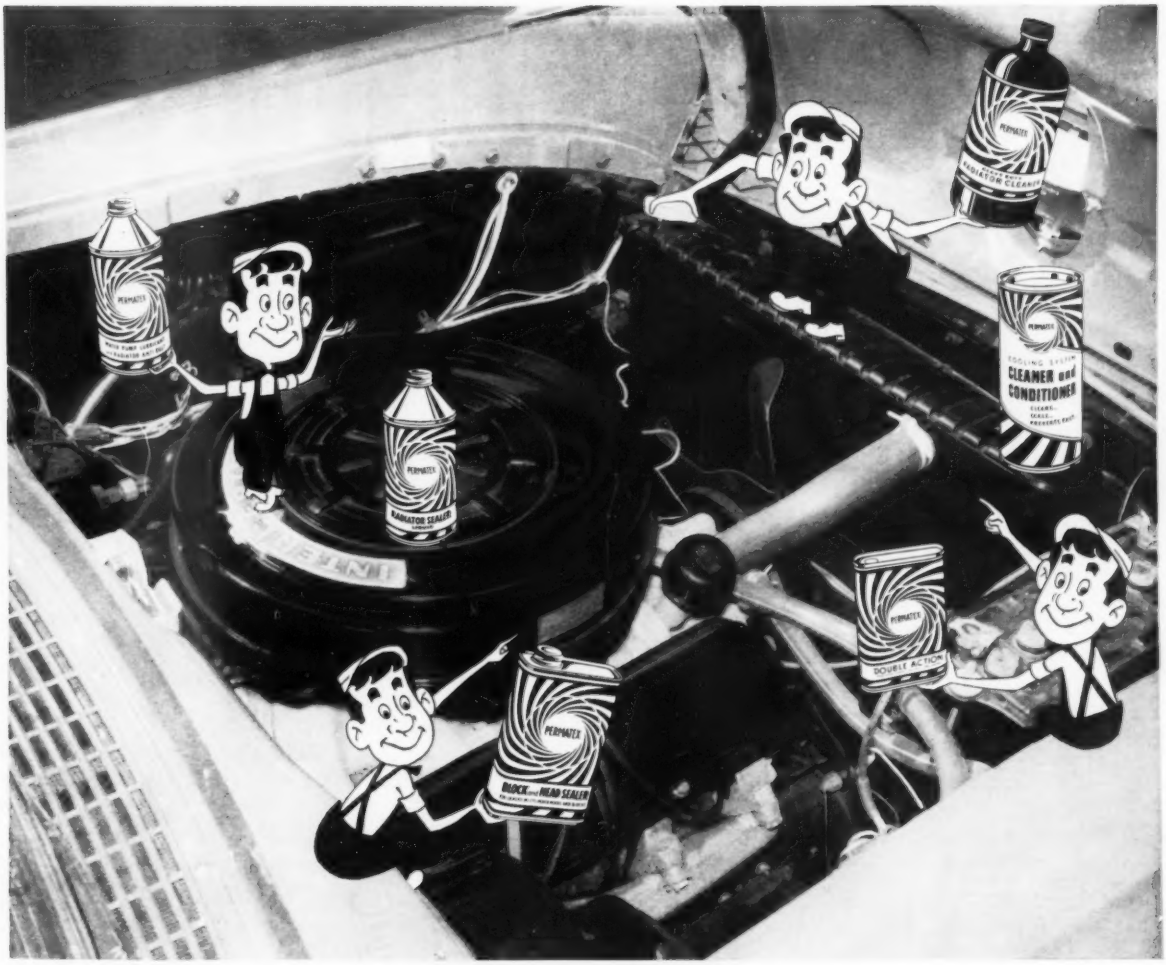

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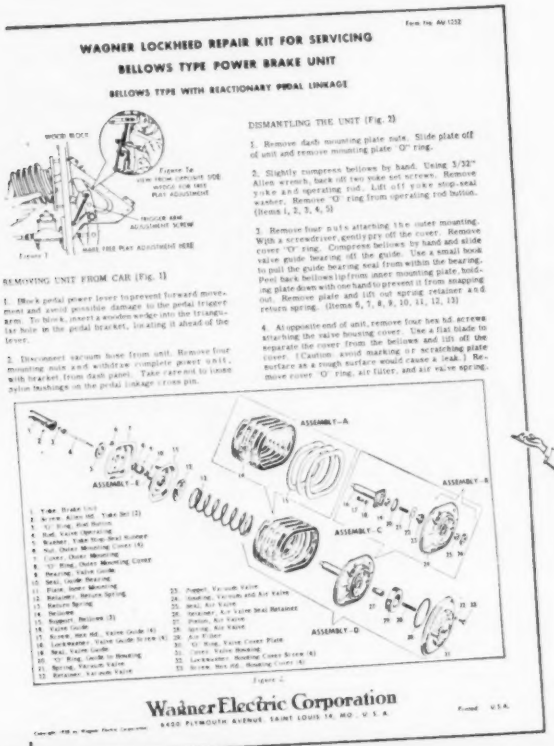

WAGNER LOCKHEED REPAIR KIT FOR SERVICING
BELLOWS TYPE POWER BRAKE UNIT
BELLOWS TYPE WITH REACTIONARY PEDAL LINKAGE

DISMANTLING THE UNIT (Fig. 2)

1. Remove dash mounting plate nuts. Slide plate off of unit and remove mounting plate "O" ring.

2. Slightly compress bellows by hand. Using 3/32" Allen wrench, back off two yoke set screws. Remove yoke and operating rod. Lift off yoke stop-seal washer. Remove "O" ring from operating rod button. (Items 1, 2, 3, 4, 5)

3. Remove four nuts attaching the outer mounting. With a screwdriver, gently pry off the cover. Remove cover "O" ring. Compress bellows by hand and slide valve guide bearing off the guide. Use a small hook to pull the guide bearing seal from within the bearing. Peel back bellows lip from inner mounting plate, holding plate down with one hand to prevent it from snapping out. Remove plate and lift out spring retainer and return spring. (Items 6, 7, 8, 9, 10, 11, 12, 13)

4. At opposite end of unit, remove four hex hd. screws attaching the valve housing cover. Use a flat blade to separate the cover from the bellows and lift off the cover. (Caution: avoid marking or scratching plate surface as a rough surface would cause a leak.) Remove cover "O" ring, air filter, and air valve spring.

REMOVING UNIT FROM CAR (Fig. 1)

1. Block pedal power lever to prevent forward movement and avoid possible damage to the pedal trigger arm. To block, insert a wooden wedge into the triangular hole in the pedal bracket, locating it ahead of the lever.

2. Disconnect vacuum hose from unit. Remove four mounting nuts and withdraw complete power unit, with bracket from dash panel. Take care not to loose nylon bushings on the pedal linkage cross pin.

Figure 2

Wagner Electric Corporation
6400 PLYMOUTH AVENUE, SAINT LOUIS 14, MO., U.S.A.

LOOK AT THESE FEATURES!

- New complete line covers all passenger cars and is available only from Wagner.
- Selection of kits includes single package unit, major kits, minor kits, packing kits, and popper valve kits.
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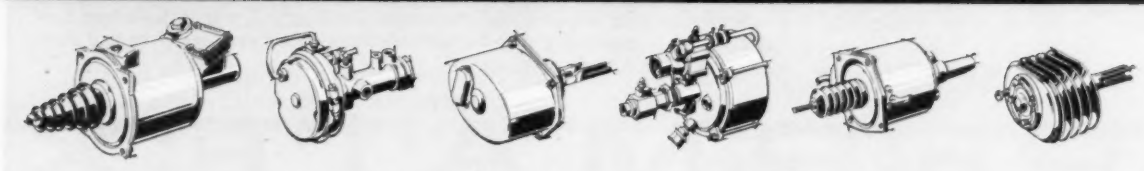
EACH KIT CONTAINS A DETAILED HOW-TO-DO-IT INSTRUCTION SHEET!

Each power brake repair kit includes an easy-to-follow how-to-do-it instruction sheet with all parts named and identified. In addition, it shows the steps to be taken in disassembly and assembly of all sub-units and components.

COMPLETE COVERAGE FOR ALL MAKES AND MODELS OF PASSENGER CARS



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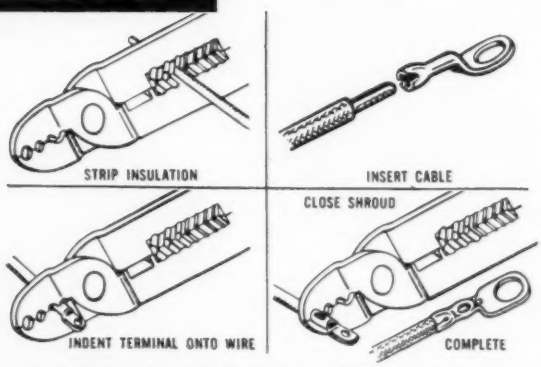
MIKE! OUR ENGAGEMENT'S OFF! I'VE NEVER HEARD SUCH LANGUAGE!
GOSH, SALLY, I'M SORRY! YOU WALKED IN JUST AS I BURNED MY FINGER WITH THAT BLANKETY-BLANK SOLDERING IRON!

SALLY, YOUR ENGAGEMENT IS ON AGAIN. THESE "STANDARD" SOLDERLESS TERMINALS SHOULD IMPROVE MIKE'S LANGUAGE — AND HIS TERMINAL CONNECTIONS — IMMEASURABLY.
GOLLY, SHERLOCK, HOW DO THEY WORK?

60 SECONDS LATER



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Published and printed monthly at Chicago, Ill., by Automotive Service Digest, a division of National Market Reports, Inc., 900 So. Wabash Ave., Chicago 5, Ill.

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Subscriptions: $4.00 for 1 year, $6.00 for 2 years, U.S. Possessions and Canada. Single copies 40c. Back copies 75c ea. Foreign subscriptions $5.00 per year. Second class mail privileges authorized at Chicago, Ill. Copyright 1958 by National Market Reports, Inc.

Charles W. Taylor, circulation manager

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VOLUME XXXXVI
No. 560

Digest

September 1958

Cover

Whether carrying the owners on a shopping trip or to a visit with friends, import cars like this are now part of the American scene—will be seen in service shops anywhere, whenever in need of skilled work. Photo courtesy Volvo Distributing, Inc.

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For October

• **Nippy Fall breezes** forecast sudden **Winter freezes**—so we bring you the annual **"Winterizing Package"** feature. Also more on: how to go about **"Opening a Service Shop,"** working on the pert little **Renault Dauphine, "Servicing Fuel Control Systems,"** starting balky engines.

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Automotive clinic

Stuck on some problem? Need help on a job? Write us about your problem on your shop letterhead and the information you are looking for will be promptly sent you.

Address your letter to Automotive Clinic c/o AUTOMOTIVE SERVICE DIGEST, 900 S. Wabash Ave., Chicago 5, Ill.

Ben Ikert, Editor

Hooking Up An Ammeter

I recently installed an ammeter on a 1958 Chevrolet V-8, but can't get it to work properly. I put it in series between the B terminal on the voltage regulator and the battery, and it shows "charge," but won't show "discharge rate" when all lights and accessories are on.

I've studied a wiring diagram for this car, but it doesn't show where the circuit is opened or closed at the ignition switch, light switch or fuse box, making it difficult to trace the current flow.

Can you give me a clue as to what I did wrong? *T.C., Johnstown, Pa.*

Answer: All the current going into any of the electrical systems, except the cranking motor current supply, goes through the wire from the hot starting motor terminal and leading to the dash. The current going from the battery also goes through this wire.

Therefore, if you will locate this wire, cut it as near to the dash as convenient and, using the same weight wire (or next gage heavier) insert the ammeter in series. In this way you get indications of both battery charge and discharge. Ordinarily the horn current does not go through the ammeter, so when the horn operates it does not show on the meter.

We Goofed—Or Did We?

I believe you goofed in your article on oil pressure in the June issue of ASD. I quote—"Oil trapped between the gear teeth is squeezed out under pressure by the meshing teeth." This is wrong!

Oil is carried around the circumference of the pump housing in the gear pockets and is delivered on the other side of the pump to the discharge port. *P.C.F., Cambria Hts., N. Y.*

Answer: Your statement that we "goofed" in the above statement is not quite correct. The oil is carried around in the pockets between the teeth, and then when the teeth of the two gears meet and seal, the oil is actually squeezed out of the pockets and discharged out the discharge oil passage.

It could be put another way by saying that the oil is carried around in the tooth pockets, building up a positive pressure which is sealed off by the meeting teeth, and then discharged. You can take your choice as to which statement you like best.

Won't Start When Warm

We've run into some trouble on 1951 and '52 Oldsmobiles not starting when warm. They all act as if the starter was bad, the battery down, or perhaps a tight engine. All these things have been checked and found to be normal.

On one 1952 Olds in particular, I have installed a new battery, cables, checked for voltage drop while cranking, cleaned and checked all connections. Also overhauled the starter, installed new armature, fields, bushings and brushes and run a ground direct to starter motor.

All this seemed to help for a day or two—the starter turns the engine fine when it is cold. But after the car has been driven five or six miles and then stopped, the starter will not turn the engine. A little shove at these times and the engine starts and runs with plenty of pep.

Any suggestions? *T.C.C., New Philadelphia, Ohio.*

Answer: It seems to us that careful testing should give some information that will give a clue to the trouble. First, put an ammeter in the cranking motor circuit to check the ampere draw. This should not be over 200 amps. At the same time, check the voltage drop with the cranking motor operating. Voltage should not drop below 10 volts at the end of 15 seconds. Check the battery to be sure that the gravity is above 1.250 (even new batteries can be low in charge).

Next check the voltage at the battery side of the ignition coil with starter running. This should not be less than 9 volts. If it is less, perhaps the by-pass circuit which cuts out the series ballast resistor is not working.

Another thing you might check is the compression pressure when the engine is hot, just to be sure that there is no chance of the hydraulic lifters being pumped up and holding the valves slightly open.

Truck Engine Speeds

What is the maximum r.p.m. of an engine on a 3-ton or larger size truck when the vehicle is coasting down hill? The governed speed on most of our trucks is 2800 r.p.m. When descending a steep grade in second gear with a load, is the maximum governed speed as indicated on the tachometer too high? Will a high engine r.p.m. cause a crankshaft to break? *K.K. Lahaina, Hawaii.*

Answer: The maximum speed of a truck engine will depend on the type of engine. If it is one of the long stroke, heavy-duty six cylinder engines, about 3200 r.p.m. should be top speed. On the newer square V-8 engines the speed may, in many cases, run up to as high as 4400 r.p.m. without danger of breaking anything, unless there are flaws in the parts.

We are unable to say whether the maximum speed as indicated on the tachometer is too high, since you do not state the kind or make of engine you are referring to.

In general, if you will look at the engine specs, the speed at which the engine develops its rated horsepower is a safe operating speed, at least for short periods of time; and for short periods such as going down a hill, even a couple of hundred r.p.m.'s would be unlikely to cause trouble, though not recommended.

WHEN CHANGING YOUR ADDRESS

Please notify us 5 weeks in advance. Supply us with both your old and new address, including address label from current issue if possible. Copies we mail to your old address will not be delivered by the Post Office unless you pay them extra postage. **Mail address changes to Circulation Dept., Automotive Service Digest, 900 South Wabash Ave., Chicago 5, Ill.**

NEW Snap-on ANAL-O-SCOPE

. . . floods garage with tune-up business

Ed and Wally's Garage, Kenosha, Wis., was the "proving ground" for a new *Snap-on* Anal-O-Scope . . . a test under actual working conditions.

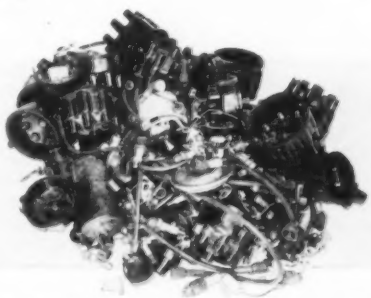
Wally Regnery, the tune-up expert, got a short briefing by a *Snap-on* man. After a few test runs, he was doing a complete check of a six-cylinder engine in seven minutes, an eight-cylinder in ten minutes. His regular equipment took twice as long.

Mysteriously, word about the Anal-O-Scope got around. Without an announcement, people began coming in, wanting their cars checked on that "fantastic machine." In less than two weeks, Wally "scoped" 30 cars — without advertising, without pressure, without build-up.

The parts business was terrific. The Anal-O-Scope is a *natural* merchandiser. People don't argue about replacing faulty plugs, points, rotor, etc. when they see these parts show "bad" on the screen. Look at the pile of parts Wally replaced in less than a month! And there wasn't a single comeback on an Anal-O-Scope tune-up.

Wally likes the easy-to-read trace pattern. If there's trouble, it pops right out on the 'Scope.

Wally Regnery runs the patented ignition reserve test. This electrically loads the ignition system to check power reserve for high-speed and hard-pull conditions. The Anal-O-Scope also tests dwell or cam angle, breaker points, distributor, condenser, spark plugs, valves, primary circuit leakage and resistance, secondary circuit resistance and insulation.



Look at this pile of faulty parts — weeded out by the Anal-O-Scope in less than a month. What a money-maker!

You can boost your tune-up profits just as Ed and Wally have. Get the Anal-O-Scope story from your *Snap-on* man now. Ask about the low, easy payment plan. Convince yourself with a demonstration.

P.S. Yes, Wally and Ed bought the Anal-O-Scope.

MT-615 Anal-O-Scope
Complete with all accessories — nothing else to buy

SNAP-ON TOOLS CORPORATION
8018-128th Avenue • Kenosha, Wisconsin

Instrument corner

Conducted by The Instrument Man in the interests of simpler, faster, more satisfactory—and more profitable—service operations.

• WHEN THE INSTRUMENT MAN dropped into the shop of one of his customers, he was greeted with, "I've got one for you this time!" Then Bill went on to tell about a job that he had to do recently.

An owner brought in a 1955 Studebaker. He was just about ready to sell the car, he'd had so much trouble; but luckily for him, he was referred to Bill's shop. He told Bill the engine had been tuned five times in the last sixty days, each time getting new points, new condenser, new spark plugs, and one new fuel pump; and of course, a substantial bill in each case—but no improvement in performance.

A friend of his recommended another shop where he was advised to get a bigger battery, which he did, but the same trouble was there—the car would not start without a push! It must be the starter, said the shop man, so the starter was replaced. This did not help, but while the car owner was talking to the shop man, a parts jobber salesman happened to come in and hear the conversation. He said, "Why don't you take the car to 'Bill's Auto Clinic'; he is a pretty good trouble shooter and probably can lick your trouble."

So the motorist went to see Bill, who went through a process of elimination and in just eleven minutes found that the coil was defective. A new coil was installed at a cost of about $3.75—and the engine started up on the first compression. That was six weeks ago, and the engine has started readily every morning since. The man was so well pleased that he took the trouble to call Bill up and tell him how nicely the engine starts and to say that he is going to send all his friends in need of service to Bill.

The Instrument Man then went on to call Bill's attention to the fact that on six volt systems without a ballast resistor in the primary ignition circuit, the voltage will normally drop about one volt, even with a fully charged battery, so that the starting ignition voltage is reduced. If the coil is not in first class condition, it will not put out enough high tension voltage to start the engine, even though it will run the engine under the full battery voltage of six volts. This explains why the coil would not start the engine but would run it after being pushed, which did not put a heavy load on the battery.

This also explains why a coil may show a spark when the breaker points are opened and closed by hand, but still the coil may be defective. When there is any reason to suspect a bad coil, usually by elimination, either test the coil on a coil tester or replace the coil with one that is known to be good. A simple step like this could have saved this motorist a lot of money and much inconvenience.

WHY INSTRUMENT CORNER?

Because we know the help he's given so many shops first-hand is just as valuable in the re-telling as it was in the happening, we've asked The Instrument Man to pass along some of his more interesting experiences. As an old-timer in automotive servicing who is distinguished by the fact that he's kept up-to-the-minute on developments in his field, The Instrument Man gets many calls for help from friends, acquaintances and even strangers, in shops large and small. He generally solves the cases, because of his understanding and appreciation of trouble-shooting instruments.

. . . It Could Happen To You

A 1954 Oldsmobile "88" would not run over 65 mph. It had been given a lot of attention in the way of new coil, carburetor overhaul, new spark plugs, rebuilt distributor, and more new plugs, points, etc. Still the car would not hit over 65. The possibility of a slipping transmission was considered, but it was found that there was no trouble there.

On the recommendation of a friend, the car was taken to Ray's Garage. Ray is a pretty smart operator, and on checking the engine he found that the vacuum dropped to 9″ Hg. at 2000 r.p.m., no load engine speed, indicating to Ray that there was engine back pressure due to a faulty exhaust system. So Ray put in a new muffler, and still there was the 9″ Hg. vacuum at 2000 r.p.m. He was puzzled and couldn't figure out what was wrong, so he gave the Instrument Man, a ring on the telephone. He explained what had been done and asked what the I.M. had to suggest. He was told to remove the exhaust manifolds and cross pipe, and to look for anything out of order.

What he found was as surprising as it was unusual. The heat riser valve, while appearing to be free when externally checked, was found, when disassembled, to have grooves worn in the housing which when in the "heat on" position or when cold, locked itself closed, but when touched from the outside weighted lever, immediately freed itself and appeared to be operating correctly. The excessive end play in the shaft apparently was the cause of the chattering on acceleration which resulted in wearing the grooves in the valve housing.

Replacing the defective manifold cured the trouble. This might never happen again in a hundred years, but the fact that it *did* happen shows that it *can* happen, and is always a possibility on other cars.

A Simple Test Does It

The Instrument Man's neighbor hailed him as he was starting toward his garage to get his car out. "Hey, Jim, I've been having a h - - - of a time with this car. On Wednesday my neighbor on the other side had to give me a push to get started and I went to the garage where I usually go for service. There they gave the battery a fast charge, and the car worked all right during the day. Thursday morning I had to get pushed again and went back to the garage. They told me this time that the generator was bad and the regulator too, so they replaced both and fast charged the battery again. The rest of the day I had no trouble in starting.

(Continued on page 54)

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MarPro, Inc., 168 N. Michigan Ave., Chicago 1, Illinois

BY HERB CARRIER
Detroit Editor

Spokes from the "hub"

Hot on the heels of forthcoming 1959 model announcements comes a "new" breed into the field—do-it-yourself has dribbled over into the automobile manufacturing business. At least one newly formed company is putting all the parts of a 1903 (that's right, '03) car (newly manufactured, of course) into a box and shipping them to starry-eyed but not-too-rich old car enthusiasts. The idea being that the buyer assembles his own antique automobile. The only modern features these cars will have are sealed beam headlamps and hydraulic brakes to make them suitable for road use.

* * *

A foreign manufacturer is doing the same thing with a brand new car. This can be imported as a box full of parts and assembled "by hand".

* * *

Soon mechanics might find it profitable to erect a sign as the union barber did when a cut-rate barber opened up across the street with a sign reading, "Haircuts $1.00". The legitimate barber then displayed a sign reading, "We Repair $1.00 Haircuts".

* * *

Good news for the operators of independent repair shops. There is a training program underfoot which will enable you to keep up with correspondence-type service and sales information right in your own shop. Available to you on a continuing monthly basis, it might be just the thing to help keep informed. It's a nice gap-filler between the factory manual and the trade magazine. Cost is reasonable too.

Pulsation regulation devices for high pressure fuel pumps are being produced in greater quantity. These started originally as gadgets put out by specialty houses, but with some fuel pumps putting out up to 6½ pounds of pressure the de-pulser is getting to be a must. If some of your customers, who own late model cars, are complaining about stalling, flooding, etc., perhaps the answer is to install a de-pulser in the gas line from pump to carburetor.

* * *

One of the best torque wrenches ever used was the mechanic who tightened rod nuts until he slipped a disc in his back. Unfortunately, the industry would lose too many mechanics if proper torquing depended on this method, but it would guarantee against overtorquing if all mechanics' discs popped out at the right time.

* * *

Recently, your reporter was in on the conception of a new idea for torque specifications. Partly as a result of our efforts, at least one manufacturer—American Motors—is including a Torque Wrench Conversion Table in their 1959 Technical Service Manual. This table will enable the mechanic to apply the recommended torque with any length wrench or combination of wrench and adapter.

* * *

The reason for this information is that some mechanics add adapters or extensions to a torque wrench and do not allow for the extra leverage. For example, if a mechanic used a 9 inch torque wrench with a 3 inch adapter, the reading of 7 foot-pounds on the torque wrench scale would have an approximate torque setting of 9¼ foot-pounds. Torque specs are getting critical. It's important to compensate when using adapters or extensions; hence the value of a conversion table.

* * *

Some complaints are trickling into manufacturers concerning no slip rear axles that appear to be O.K. mechanically, but won't pull their way off slippery surfaces. This condition can exist, say the engineers, when one of the rear wheels is on an extremely slick surface and the other is on a good dry surface. Under this condition, it's possible for the wheel on the slippery surface to spin indefinitely.

The answer is to apply the parking brake slightly to produce enough resistance to the spinning wheel to cause axle lock-up. Then, the no-slip feature will operate correctly.

A little owner education is called for here. Be sure your customers understand that this condition *is normal*. It will help them get the most out of their cars, and it can save you the embarrassment of tearing down a good axle.

* * *

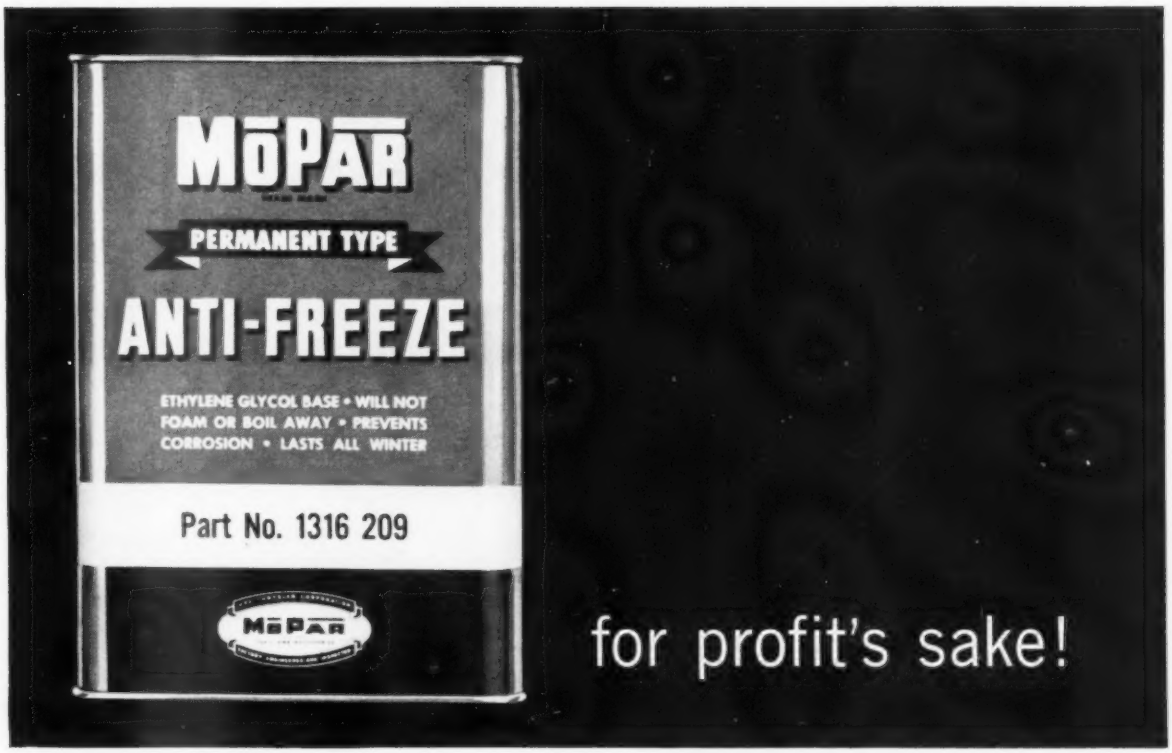
Noises from some working mechanics indicate that there is an effort underway to have the garage owner furnish hand tools for all his mechanics. This could be a real boom to the iron bender, but it would certainly add to the already high overhead of doing repair business.

* * *

On one hand the mechanics are right. More and more special tools are needed to do even the simplest jobs. On the other hand, it's an impossible thing to do. Personally, I'm all for it (I don't own a garage), but my sympathies go to the troubled owner who employes 10 or 15 mechanics. He's in for a real shock if he's forced into footing the bill for hand tools.

* * *

"Trouble is the price of advancement," so stated Charles F. "Boss" Kettering of General Motors Corp. at the recent award dinner for the Fisher Body Craftsman's Guild held in Flint, Mich. "So", continued Mr. Kettering, "it's logical to assume that the more trouble you are having the greater advancement you are making". This is sound consolation from the "Sage of GM" that could be of help to all of us if we accept troubles as part of progress—and overcome them one by one with hard work and a generous sprinkling of humor.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Your Champion supplier will give you a $10 allowance for any old spark plug service unit—regardless of make, model or condition. Trade now!

It's your best chance ever to put this modern spark plug merchandiser to work for you!

Your Champion supplier will give you a $10 trade-in allowance on the purchase of a new Champion "Series 800" spark plug cleaner and tester during September and October. Regardless of make, model or condition, your old service unit is worth $10 in trade from now through October 31, 1958.

We're making this special offer because we want you to have the most modern and efficient service unit available—to help you do an even better spark plug servicing job in less time. And, naturally, when you use one of these new units you sell more Champion Spark Plugs. (The fall season is an excellent time to sell new sets of Champions for easy starting during cold winter months.)

The floor model is $67.50, less a $10 trade. The bench model is $64.50, less $10 trade, during September and October only.

One of the outstanding features of this "Series 800" unit is the "built-in salesman"—a new type of sparking-indicator gauge that shows directly if an old plug should be replaced. It eliminates the bother (and possible inaccuracy) of checking the old plug against a new one. This new gauge measures a plug against a fixed standard. Your customer can *see for himself* if new Champions are needed. You don't have to sell the new Champions—you just install them.

There are real profits to be made from spark plug sales and service. And this advanced Champion cleaner and tester—now available on this special offer—can help you make more money—in less time and with less effort. *Get one from your Champion supplier now!*

NEW DOUBLE-FILTER CLEANER BAG – separates dirt and dust from cleaning abrasive – faster, more dust-free cleaning action – simple to service.

NEW SPARKING-INDICATOR TESTER DIAL – a new, simpler method of testing spark plugs – single plug test saves time – sells new Champions *fast.*

HEAVY-DUTY WATER TRAP — now standard equipment — keeps abrasive compound free from air-line moisture – protects air lines, etc. from rust.

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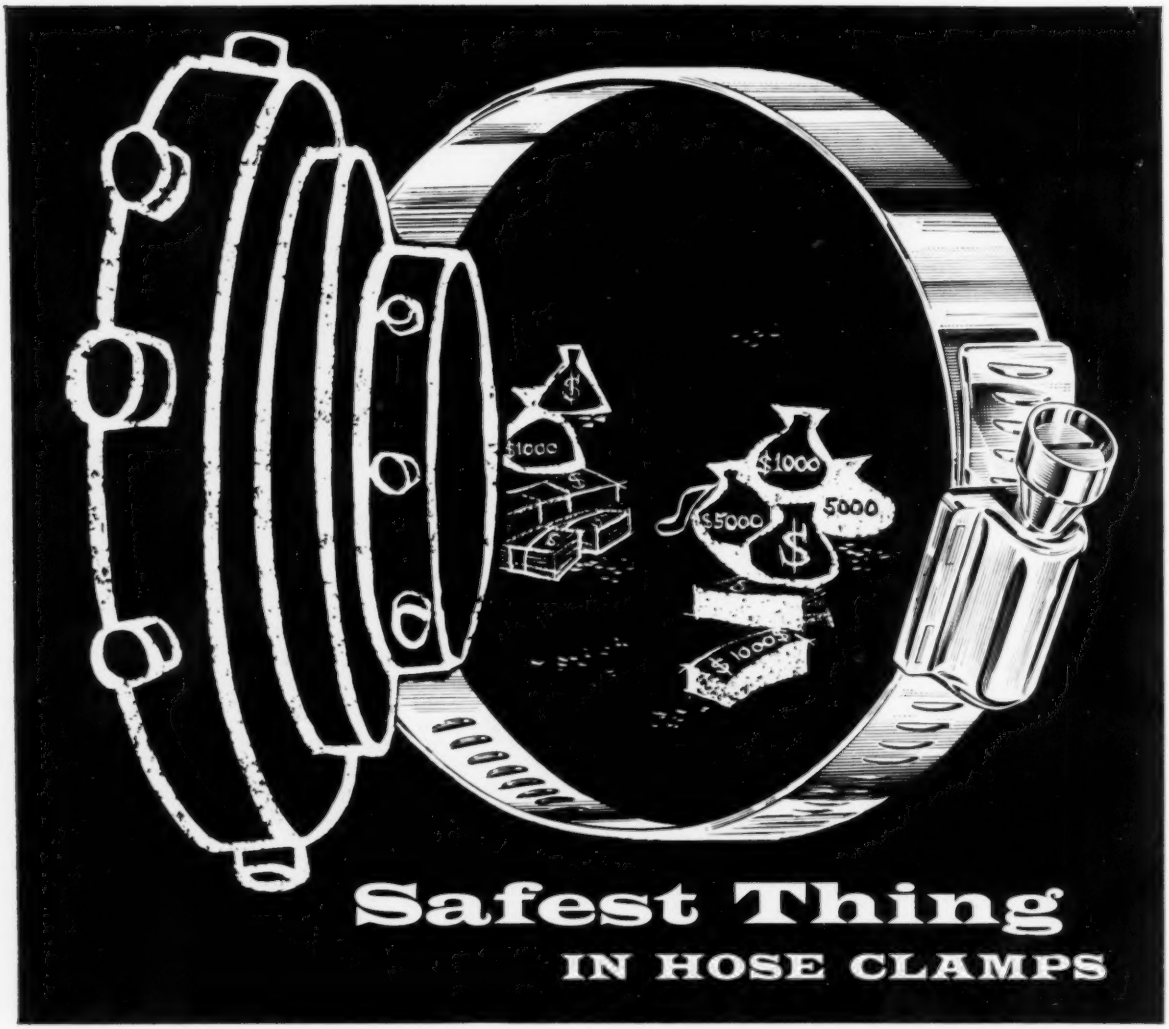

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Editor's page

Are you selling yourself fully?

● IN PRACTICALLY EVERY community of the country, the "invasion" of the small and import cars continues to make itself felt. The progress of this invasion may well forecast more growth in popular demand and acceptance of the smaller cars, as second cars or as the family's single means of motor transportation.

Those close to the import and small car picture predict a yearly U.S. market of at least 300,000 such motor vehicles. Records show that already more than 200,000 Volkswagens are piling up mileage for their owners here. With the volume of import cars growing, metropolitan and rural areas are dotted with various types and makes... Consul, Anglia, Opel, Simca, Fiat, Vauxhall, Volvo, to name a few.

Considering our own manufacturers, Rambler's boost from 12th to 7th place in production seems another indication that the smaller car has something which a certain segment of the motoring public wants and is ready to buy. What will be the eventual role of the small car in the U.S., is anybody's guess. But one thing is sure: increasing registrations of import and domestic small cars brings dealer-operated and independent shops a new service potential. These shops are the rightful heirs to such service. They are the logical answer to the need for repairs on small cars, both import and domestic.

Borne out in the interview on Page 14 of this issue, is the fact that dealer and independent shops alone have the equipment and personnel necessary to handle major service and repairs.

Repairing a small car is basically no different from doing the same work on a large car. Usually, it is much easier. Simpler design, smaller units and greater accessibility make this possible. Nor need the shop man be concerned about metric threads on nuts and bolts of the imports. Tool makers in this country have all necessary open end, box and socket wrenches, tap and die sets, metric valve guide pilots, etc. From there on in, the shop's conventional tools and equipment answer all requirements.

Living with the "facts of life," day after day, week in and week out, is "old hat" to the automotive service shop. So shop management can—and should—easily accept and advantageously act upon two current realities that are featured in this issue.

The interview mentioned clearly points out the advantages that dealer and independent shops enjoy as true, full-range service centers. The article "Small car in your future," covers the service shop angle of this much-discussed market development.

We all know that, regardless of what car the American motorist buys, it will need service. Further, we and our readers know what's required for the kind of service that keeps cars rolling and customers coming back with repeat business... and where it's found. Viewed factually and dispassionately, the "bugs" really do mean business—service shop business. They represent one more of the many business opportunities close at hand for any alert, well-managed dealer or independent service shop that is more keyed to today's certainty than tomorrow's possibility.

Ben Ikert
EDITOR

Who is getting the service dollar?

Interview*

By BEN M. IKERT
and
GEORGE A. WHITTINGTON

DR. GEORGE H. BROWN, Marketing Research Manager for the Ford Division, Ford Motor Company, has been with that firm since October, 1954, when he joined the organization as Consumer Research Manager for the Division. Prior to his association with Ford, Dr. Brown was for 17 years Professor of Marketing at the University of Chicago. He has been marketing consultant to many major firms, such as General Mills, Toni, Armour and Company. The author of several books and numerous articles on marketing and economics, he is currently a consulting editor to the publishing firm Henry Holt & Co.

● BUSINESS IS ONE of those things in which most of us admit to being expert. It ranks in that respect with politics, medicine, international affairs and the weather, as a topic we often discuss—even debate—with our peers.

Fortunately, almost all of us also know better than to believe our own contentions are necessarily indisputable . . . or our "hunches" always supported by facts. We listen and learn whenever we have a chance to corral a genuine expert—especially if the subject is business. Of all popular subjects, business conditions commands the most attention—for it concerns the source of income that makes all other interests and activities possible.

With that in mind, your ASD editors set out to verify a few facts about the automotive service business. As one of the healthiest segments of the national economy currently, it is receiving a very great deal of attention and discussion. Many voices are raised publicly in description, and in explanation of what types of retail service outlets are getting the customer dollar for repair and maintenance.

Much has been written and spoken about the shift of this business from the dealer service department and the independent garage or service shop, over to the service station. If such is the case, then dealer and independent shops can profit by knowing the extent of such a shift, the reasons, and all other available facts. With reliable information, these shops can plan and practice sound policies to retain present customers and win new ones.

So in behalf of our readers, we approached the marketing research group of the Ford Division, Ford Motor Company. That group has been conducting a study of car owner purchases dating back many years . . . on a statistically sound selection of customers. These individuals represent a cross-section of popular cars, as well as all the major geographical areas and income brackets.

While much of the information obtained from this long-range research is, understandably, not for publication, Dr. George H. Brown, Marketing Research Manager of the Ford Division, very kindly agreed to release some of it in answer to our questions. The question-and-answer session went something like this (not necessarily verbatim):

Question: In a community with a typical number of dealer service shops, independent service shops and filling stations, are there common denominators—such as age, history, use or ownership, for example—among cars whose owners take them to a given type of service outlet?

Answer: It depends primarily upon the age of the car, and whether it was purchased new or used. Owners of cars bought new definitely tend to return to the new car dealer more frequently than those

*One of a continuing ASD feature series.

who have bought used cars.

Since used cars tend to be older cars, and used car owners tend to have lower incomes than new car owners, there is of course, a relationship of repair usage in those factors.

In general, the new car dealer tends to get a fairly high proportion of the car service work during the first 3 or 4 years the car is in use—with a marked fall-off in later years.

Q. As the car gets older, who gets the service work?

A. Independent garages are the first beneficiaries of the loss in business to the new car dealer. But after the car is 6 or 7 years old, the independent garage loses substantially to service stations and to home repair work.

Q. Do you find any indication of a trend developing, over the past few years, in where car owners have their service work done? If so, could you describe the situation briefly?

A. Over the past 5 years, there is an indication of a minor trend toward service station outlets as a source of maintenance work—however the specialty shop has engulfed an even larger share of this market. These segments of the field have gained at the expense of the independent garage and the new car dealer. Service stations have continued to increase their proportion of lubrication jobs, at the expense of independent and dealer shops; and are currently running at 111% of their 1952 level.

New car dealers have held their share of the market in major mechanical repairs, as well as minor mechanical repairs. In the latter category, there has been some increase in the share done by service outlets at the expense of work done at home.

Q. How marked are these trends, Dr. Brown?

A. The changes recorded are relatively small, although they are beyond the limits of statistical variations and hence, represent measurable trends. The do-it-yourself group has declined to 36% of the level attained in 1952; while car dealers maintain up to 85% of the 1952 level.

Q. Is the "do-it-yourself" trend we hear so much about, a big or growing factor in the service picture generally speaking?

A. According to our information, the do-it-yourself segment of the car service market is declining rather than increasing. In our judgment, this is due partly to the declining importance of the very old car, which came into being during the war when no cars were being produced; and partly to the increasing complexity of the modern-day car.

A third factor is the steady increase in average incomes and the greater willingness of people to have cars repaired rather than attempt the job themselves. The do-it-yourself movement has definitely not been as important a factor in automobile repair work as it has apparently been in home maintenance work.

Q. Do the later hours and more numerous locations of gasoline service stations, or the national promotions in their behalf by the petroleum companies, seem to be attracting more mechanical work to them, other than light servicing?

A. The greater convenience of service stations, in terms of number and location, and hours and days of the week they are open, constitutes a significant reason for their share of the car service dollar.

Another significant advantage of these outlets is their reputation for friendly service.

However, a major factor preventing them from taking over a larger share of the service dollar is that they do not have the equipment or personnel necessary to handle complicated repairs.

Q. Do your studies show any factors in the spending of the customer's service dollar that suggest action by the dealer service department or the independent shop?

A. The fact that car servicing tends to drift away from the new car dealer and the independent garage, at a time when expenditures for service on a car are still quite high, suggests that these service outlets should give greater attention to the total needs of car owners in the 3- to 8-year old model groups. Most of those owners come to the new car dealer or independent shop for major mechanical repairs—but tend to have maintenance work done elsewhere.

Merchandising and promotional efforts aimed at these car owners should be designed to bring the shop more service volume, without increasing the total operating costs to the customers.

While car dealers and independent garages can do little to overcome the convenience of location that service stations enjoy, they can match them in all other aspects of servicing that have proven attractive to car owners.

* * *

We and our readers are indebted to the Ford Division and Dr. Brown for a **few** facts about who is getting the service dollar today, and how.

It seems there hasn't been a revolution in the automotive service field after all. Dealer service departments and independent shops are, as they have always been, the backbone of this highly specialized industry. They alone have the equipment and the properly trained personnel to meet the service needs of the modern car fully.

The route to more service volume for the dealer and independent shops, is apparently the old familiar one: **sell what you have!**

Lighting the service shop

Everyone knows "seeing is believing" . . . but experts also know that many other tangible business benefits are gained by using light right. It's easy to see why automotive service shop management has a stake in the kind of lighting that best brings up the work—and the profits.

• HOW WELL can a person see? . . . How **fast** can a person see? . . . **What** can a person see? At first glance, these questions may seem out of place in connection with the operation of an automotive service shop. But on second thought, they aren't out of place at all, because being able to see well is one of the most necessary elements in doing any job.

There isn't a single service operation—grinding a valve, honing a cylinder, or adjusting a carburetor—that doesn't depend upon a mechanic looking at *and seeing* what he is doing. In many respects how well he does a job depends upon how well he can see the job.

There are three basic requirements in the act of seeing:

- There must be something to see.
- There must be someone to do the seeing.
- There must be light enough to see.

When it comes to having enough light to see by, obviously no automotive service shop attempts to operate in complete darkness. However, there may be some shops that are trying to do a job in semi-darkness, or, at least, in the twilight zone of good lighting. Just because a shop has been doing a job for ten or fifteen years with the present lighting set-up is no proof that it has adequate lighting. In fact, if the lighting system is ten or more years old, it is a pretty sure bet that the effective light in the shop is inadequate by today's accepted standards.

One way to look at the value of good shop lighting is to consider its effect on shop efficiency. The process of seeing is slowed down when shop lighting is inadequate. Measured in shop efficiency, slowing down the process of seeing adds up to dollars wasted in shop operating costs.

Another way of measuring the effect of inadequate shop lighting is to consider the appearance of the shop as seen through the eyes of the customer. A well-lighted shop looks attractive and inviting. A poorly lighted shop does not attract customers; instead, poor light often influences a customer to pass up the shop when his automobile needs service. When the lady of the household is looking for a place to have the family car serviced, there is little doubt

By FRANK E. LEE

Routine cleaning and replacement of aged and burned-out lighting elements will restore the efficiency of this well-planned general lighting system to good advantage.

Replacing worn-out or burned-out lighting elements maintains light output at the peak efficiency required for best work.

about her reactions to inadequate light. Dim lights would make even a new department store look shoddy and uninviting—she would go to a more attractive store up the street or in some other part of town. Poor light will make an automotive shop look shoddy and uninviting—she would not go there either.

So it takes only a few moment's thought to see how important good lighting is to the automotive shop.

SPEED OF SEEING

It takes time to see. How much time, depends on how well one can see and how much light there is to see by.

In many respects, the human eye can be compared with a camera. As the amount of light increases, the amount of time needed to take a picture decreases. If the shutter opening remains the same, more light requires a faster shutter speed; this means less time to take a picture. The same reaction occurs in the human eye. If the light is insufficient, the eye has to strain and look longer to make out the details of the object it is trying to see. If, on the other hand, the light is adequate, details of the object stand out sharp and clear. The eye can make out the details in less time; the result is faster seeing. Thus, the essence of the speed of seeing is the observation of details in the shortest possible time.

Engineers have shown that increasing illumination from one foot-candle to as little as 20 foot-candles will enable a person to see three times faster. Improvement in perception and recognition of surrounding objects affects practically everything a mechanic has to do around the shop. More time can be devoted to profitable activity when the speed of seeing is increased.

Speed of seeing is only one benefit gained by good shop lighting. Another is reduction in the physical fatigue of those who work in the shop. The act of seeing involves the use of thousands of tiny eye muscles and physical and nervous energy. The drain on the body's reserves of nervous and physical energy increases whenever there is continued strain and effort to see. This is a common source of physical and nervous fatigue, which causes poor workmanship, increases accident hazard and slows down the individual's work.

CONTRIBUTING CONDITIONS

The ease and speed of seeing will be increased whenever anything is done that improves the quantity and quality of the lighting. Improvement of seeing conditions will save nervous and physical energy. To summarize the advantages—good lighting helps maintain the mechanic's health, physical fitness, and ability to work efficiently during the time he spends on service jobs.

Good lighting is only one of the important factors in the act of seeing. Others involved in this problem are:

- Contrast in and around the working area.
- Brightness of the object.
- Length of the job.

A definite contrast between the object and the background makes seeing easier. More light is required for the same seeing ease if there is little contrast. To illustrate the importance of contrast, hold an object against a background of the same color or similar color. Notice how small details and edges seem to blend into the background and become less distinct. Next, place the object against a contrasting background. Small details and edges stand out in bold relief, and the object is easier to see.

Brightness is a measure of the amount of light an object reflects. Aluminum, sand-blasted brass, and similar metals have a diffused reflecting surface. Polished steel, aluminum, or brass reflect a glare from the light source.

The prevention of annoying glare is an important element in developing a suitable shop lighting plan. As a rule, the answer lies in increasing the size, and correspondingly reducing the brightness, of the light source. An alternative is to increase the general level of illumination without increasing the brightness of the lighting equipment—such as by installing more lighting units. This will reduce the effect of the reflected glare, because the glare usually is not much stronger than the brightness level of nearby objects.

The length or duration of the job is also an important factor, because it has a direct relationship to nervous and physical fatigue. For example, a portable drop light may be satisfactory for a short-time job such as checking the oil or radiator, or for a minor under-chassis adjustment; but it would be inadequate for an engine or transmission rebuilding job.

A good, practical suggestion is to provide light in excess of minimum levels required for good seeing. This will help prevent undue fatigue and eye strain during the performance of prolonged and continuous visual work.

(Continued on page 20)

What is a foot candle of light?

A foot candle of light is the amount of illumination produced by a standard candle at a distance of one foot. In the field of photometry, a candle used as a standard or unit of illumination is usually of spermaceti and is so made that it will burn at the rate of 120 grains or 7.8 grams per hour. Spermaceti is a yellowish or white waxy solid which separates from the oil obtained from the sperm whale. Fluid spermaceti is found in a cavity of the head of the whale and in certain regions of the back.

No doubt the use of a spermaceti candle of a standard size as a means of determining the brightness of artificial light springs from the fact that most candles were made from spermaceti when comparisons were first made between various types of artificial lights. In any event, lighting is an exact science and a great deal of progress has been made in the field.

Shop Lighting . . . CONTINUED

One of the best ways to solve the automotive shop lighting problems is to determine the amount of light required in each area, then take the steps necessary to provide those amounts. The basic objective is to provide a moderate level of general illumination, plus adequate supplementary lighting in those areas where it is required.

As a rule, the correct ratio between general and supplementary lighting is attained when the general lighting system provides about one-third of the total foot candles. For example, today's standards indicate that general shop lighting should be about 30 to 35 foot candles. Supplementary lighting can be used whenever more than the 30 to 35 foot candles is required in any given area. The moderately high general lighting helps avoid extreme contrasts in brightness between the work areas and adjacent surroundings.

The recommended foot candles of light are the levels that are expected to be maintained in service. On this basis, allowances should be made for the usual losses of light output caused by dirt collecting on the lighting units, walls, and ceilings. Also to be taken into consideration is the gradual loss in output of the lighting elements that occur with age.

Foot candle values in the following chart are the amount of light at the normal working level whether a horizontal, vertical, or oblique plane. In storage areas or pasageways the light measurement should be made on a horizontal plane 30 inches above the floor.

AUTOMOTIVE SERVICE SHOP LIGHTING RECOMMENDATIONS

Shop Area	Foot Candles
General Lighting	30-35
Repair Department	50
Machine Shop	100
Parts Inspection	100
Paint Shop	100
Body Shop	100
Welding Shop (High Intensity Supplementary Light)	1000
Pit (Work Areas)	50
Washing Department	50
Stock Room	20
Stairways, Corridors, and Passageways	10

TYPICAL EXAMPLES OF GOOD SHOP LIGHTING

Under-chassis work—Lights mounted in the walls are recommended for pits. As a rule, refractor type covers for the light units are used to direct the light up towards the automobile under-chassis and away from the mechanic's eyes. Where under-chassis work is performed with a lift, the problem is to focus the light on the working plane when the lift is in the raised position. This can be done with wall-mounted units or with portable units on stands or rollers provided for this purpose.

Work benches—Mechanic's work benches can be lighted with channel type fluorescent reflectors extending the entire length of the bench area. Supplementary light, provided by intensifier units, can be placed over lathes, drill presses, valve grinders, and related equipment installations. Similar arrangements can be used to provide the additional light required for carburetor adjustment, generator rebuilding, and other assembly and adjustment operations.

Wash rack—Lighting units used for wash rack illumination should be directed toward the sides of the vehicle being washed. Inasmuch as the vertical plane is the most important item, the lighting units should be directed at 35 to 50 degrees from the vertical to provide the proper amount of light on the automobile on the rack. In addition, general illumination from two 40-watt fluorescent lamps in a dome type fixture should be provided.

Body finishing shop—The National Electrical Code and many local electrical codes specify that spray booths and spray rooms should be lighted with units installed outside the booth or spray room. The objective is to place the lighting units away from the hazardous fume area. Underwriters' Laboratories approved lighting units should be used in these locations.

Battery department—Vapor proof lighting units are recommended in the area or room used to charge batteries or store battery acid. These units are designed for this service and will provide better lighting over an extended period than will open type reflectors.

LIGHT UNIT SPACING

A simple guide for the spacing of general shop lights is that the reflectors should never be spaced more than the height they are above the floor. Reflectors adjacent to walls should be separated one-half the regular spacing. In spacing lighting units it is well to keep in mind the main objectives of adequate shop lighting—to eliminate dark shadowy areas where the general illumination is noticeably darker than in adjacent areas. The mechanic should be able to look up from his work and rest his eyes on some more distant object without straining his eyes.

An example of good pit lighting. The lighting units are tipped to direct the light up toward the working area. Refractor glass covers can also be used to serve same purpose (Westinghouse Photo).

A drop cord is suitable for minor checks and adjustments. Better lighting is needed for longer jobs.

Actually, an even pattern of moderately high level general lighting will cause a more intensely lighted area to fit in with the shop as a whole.

Elimination of glare—Elimination of glare must be given careful consideration in planning the shop lighting layout. Lighting units should not be placed where the lighting element will shine directly in the mechanic's eyes. If glare is avoided, illumination can be made available in suitable quantities without being apparent.

Perhaps the easiest way to avoid glare is to place the reflectors out of the mechanic's normal line of sight. If this is not possible at a particular location, frosted or diffused reflector covers, or deeper reflectors can be used.

Dark shadows and glare cause excessive eye fatigue and after-images, and generally hamper seeing. These conditions cause lost time and contribute to shop accidents. Many accidents are also caused by delayed eye adaptation, when a person moves from a brightly lighted area into a dimly lit area and vice versa. The elimination of wide contrasts in shop illumination makes the shop a safer place in which to work.

Another objective of good shop lighting is to eliminate shadows in the working areas. Supplemental lights, placed in the correct position, can be used effectively for this purpose. The working plane can be lighted to permit the mechanic to work in a natural position without his shadow falling across the working area. The shadow of a pillar can be eliminated by placing a lighting unit on both sides of the obstruction. Shadows from ceiling beams can be avoided by placing the lighting units below the underside of the beams.

Right colors help—The selection of the proper colors for the walls, ceilings, floors, and tools in the shop helps in creating the best shop lighting conditions. Flat pastel shades are recommended to create a soft, diffused reflection that helps eliminate dark, shadowy areas. Finishes with a high gloss create glaring reflections that are contrary to the objectives of the well-lighted shop.

ROUTINE MAINTENANCE REQUIRED

There is no argument with the fact that good lighting costs money—but it is worth every cent it costs. Money spent for lighting should be considered as an investment. As with any other item of valuable shop equipment, the lighting system should not be installed and then forgotten. A certain amount of routine maintenance is required to keep the system at peak efficiency.

An important maintenance function, and one that is too often neglected and put off, is the immediate replacement of burned-out bulbs and fluorescent tubes. Care should be taken to replace these with new units of the same type and size.

Tubes and lamps have a normal service life, like practically everything else in the shop. However, lamps and tubes are expected to deliver a predetermined number of foot candles of light when they are in service. The output of a lighting unit may be reduced extensively by discoloration before the element burns out. As a result, it is good economy to discard inefficient units, even though they are not burned out; because the maintenance of an adequate level of lighting is more important than postponing the expenditure of the few cents required to replace a bulb or tube. Lighting elements should be replaced when they show discoloration.

The efficiency of a lighting system may be reduced by as much as 50% or more by the accumulation of dust and dirt on lamps, tubes and reflectors. This is equivalent to throwing away $5.00 of every $10.00 spent for adequate lighting. Cleaning at frequent intervals goes a long way towards maintaining the efficiency of any lighting system. A recommended maintenance program is to clean and inspect lamps, tubes and reflectors on a routine basis at least once every three months. Cleaning time is most productive if the fixtures can be unhinged or easily taken down for washing.

MAKING BEST USE OF NATURAL LIGHT

One of the best sources of light is natural daylight. Daylight cannot be used exclusively because of the wide variations in the number of daylight hours between summer and winter in many localities. Also, even distribution of light every day is impossible, because some days are bright and others are dull.

In some cases the shop is located where daylight cannot be used to any extent. However, benches should be located near large windows whenever it is possible to take advantage of natural daylight.

A north exposure is best, because the north light is even and not subject to the intense degrees of heat and light of direct sunlight. Awnings can be used to offset the brightness and heat of the sun when an east, west, or south exposure must be used. When natural daylight is used, window washing should be considered an important part of the light maintenance program.

(Continued on following page)

Cleaning dirty reflectors will increase the illumination by more than 50%. The practice is a "must" in shop maintenance.

Precision work such as this is made a great deal easier by good, properly planned supplementary lighting provisions.

PLAN THE SHOP LIGHTING PROGRAM

Planning the lighting for the automotive service shop is easier after the important features of good shop lighting have been reviewed and understood. From this point on, the solution to the lighting problem can be arrived at by a definite course of action, as follows:

Study the shop's lighting requirements—Check the effectiveness of the present lighting equipment with a lightmeter. Compare the results of these observations with the recommendations for each shop area. The course of action generally can then be determined.

If the shop lighting measures up to or better than the objective standards—fine. This means the shop lighting is good, and usually, too, it's a sign of a good maintenance program. Keep it up!

If the shop lighting is below par the answer may be to supplement present equipment or revamp the layout.

Supplement present equipment—If the shop lighting is good in spots but below standard in others, the answer may be to supplement the present equipment with additional or more efficient lighting units. In many instances existing fixtures can be rearranged or regrouped and a few new units added. The answer, of course, will depend largely upon where the additional light is needed. Also to be considered is the condition and adaptability of the existing lighting equipment.

Revamp and modernize—In some cases the only way to arrive at a satisfactory solution of the shop lighting problem is practically to start over and revamp the entire layout. If this drastic action is necessary it is worth every cent it costs. It's worth the money because it means the shop has been limping along in partial darkness. In the long run poor light costs more than good light. The cost of the new system is an investment in improved working conditions. A good return is increased shop efficiency.

Revamping of the system is also needed when the shop is enlarged or when a new building is erected.

Discuss the problem with the local power company or an equipment manufacturer. Lighting equipment manufacturers or their distributors, and the local power company, will gladly assist in studying the shop's lighting layout and in making suggestions for improvements when necessary. It is a good idea to make use of the engineering and planning skill that is available from these sources.

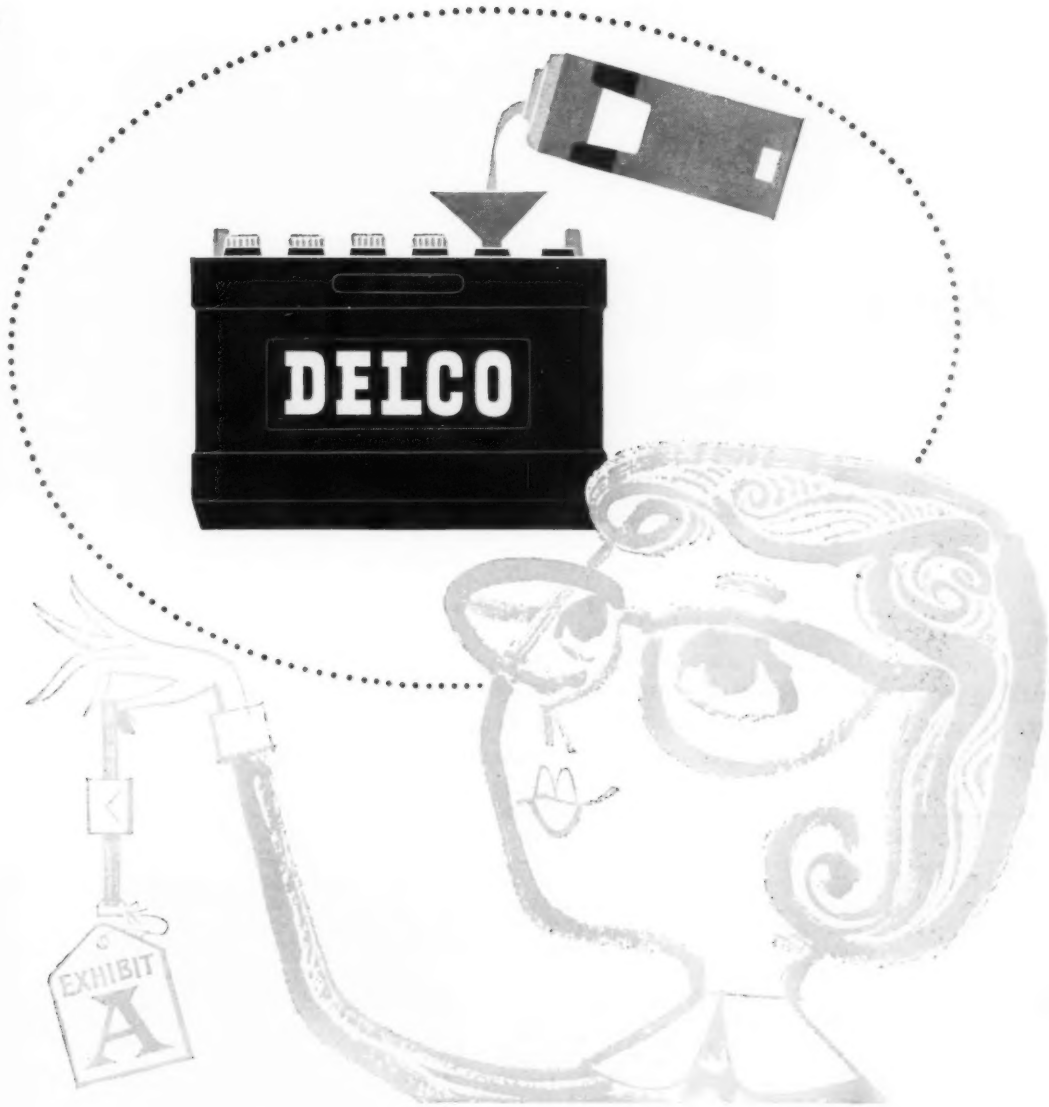
Set up a maintenance program—Set up a routine maintenance program to maintain the efficiency of the lighting system. This is a good way to be sure that the shop will have the benefits of good lighting at all times.

SUMMARY

How well a mechanic can see; how fast he can see, and what he can see, generally are controlled to a large degree by the available light. Being able to see well helps a person do a better job—faster. The result is more profits for the shop. This is a good reason to take a look at the lighting in your shop. Is there enough light in all the work areas? If you need help in checking the system or in planning some needed improvements, call the local power company or one of the lighting equipment manufacturers or his distributor. You will be glad you did. Your mechanics and customers will, too. Today is a good time to start making improvements for a better lighted tomorrow.

The assistance of the following companies in the gathering of information used in this article is gratefully acknowledged: Benjamin Electric Manufacturing Company; General Electric Company; Metropolitan Electric Company, Reading, Penna.; Westinghouse Electric Corporation.

Outdoor light, efficient lighting units in the sidewalls, and an overhead light (not shown), add up to excellent lighting for washing-cleaning area (Westinghouse photo).



LADY LAWYERS

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Buick

The beautiful 4-door hardtop "LeSabre," 217.4" overall on 123" wheelbase; headroom equal to '58 in under 55" height; featuring giant rear "picture window" of distortion-free safety glass.

Breaking in front with new-model introduction, Buick folks mean to stay out there if they can. Their entry for '59 is an array of dramatically re-styled, re-named cars melding advanced engineering with lines of fluid motion.

Once again the season for new car announcements is here, and we proudly present that of the Buick Division, General Motors Corporation . . . the first to release the details for the current year. Others in the parade now holding the attention of the nation will be introduced in October and following issues—as the manufacturers make the information available. Grapevine has it that the '59 offerings of American automobile makers may very well trigger the buying surge that will put the industry's production back at its accustomed high levels . . . and with it, stimulate the field and general business right on across the board.

• "SO NEW in concept and design that they have been given new names," this is how Edward T. Ragsdale, General Manager of Buick Motor Division describes his company's 1959 products. No longer will they bear the familiar "Special," "Super," "Roadmaster" insignia. These names have been dropped. In their place will be "LeSabre," the lowest priced in the line; "Invicta," the star performer, and "Electra," the luxury line. In addition, there is the really plush series called the "Electra 225."

HEIGHTENED EYE APPEAL

Buick's new styling is highlighted by "delta wing" rear fenders that flare gracefully outward and sweep downward into the deck lid area.

"Delta Wing" rear fenders that flare up and outward from the deck lid area, are a style highlight of the 1959 Buick line.

Wheelbases run from 123 inches on the LeSabre and Invicta to 126.3 inches on the Electra. Over-all lengths are 217.4 inches and 220.6 inches. The Electra 225 measures 225.4 inches in length and is mounted on a 126.3 wheelbase. All models are lower than their 1958 counterparts. The hardtops, for example, are somewhat under 55 inches in height, but headroom remains approximately the same as last year.

An outstanding design characteristic is the lavish use of glass. Huge, compound windshields curve back into the roof panel. This feature not only affords maximum visibility, but tends to reduce wind noise when the car is in

From the front, the "LeSabre" 4-door hardtop displays its huge compound windshield, which curves back into the roof for maximum visibility and reduction of wind noises, especially at high road speeds.

motion, especially during high-speed driving. A giant, curved rear "picture window" is used with the 4-door hardtop models. All glass is safety plate which is entirely free of distortion.

POWERED AND PURPOSEFUL

Two new "Wildcat" engines are available in '59. The largest has a cubic displacement of 401 inches. It uses a four-barrel carburetor. This engine is standard equipment on the Invicta and the Electra series. The smaller engine has a 364 cubic inch displacement and is equipped with a two-barrel carburetor. Both engines are V-8 design.

Compression ratios have been boosted to 10.5 to 1 on the big engine. Compression is also 10.5 to 1 on the LeSabre engine when it is used with a Dynaflow transmission. In addition to the twin-turbine Dynaflow, an improved triple-turbine unit is available as optional equipment.

Another option available at extra cost is a modified air suspension system. In 1959, Buick will use air bags on the rear only. Steel coil springs will be used on the front. Buick engineers claim this form of suspension couples the softness of air ride with the proven stability and good handling characteristics of coil springs.

Electric windshield wipers are standard equipment on all models. Also, aluminum brake drums, which were extremely successful last year, are now standard on all series. The brake drums have been improved by the addition of fins (60 to each drum) which create air turbulence for more effective cooling. Smoother stopping power and increased brake lining life are expected for the '59 Buicks.

Power steering has been improved to where it takes less than 2½ pounds of driver effort to turn the wheel. This has been accomplished without reducing the driver's feel of the road. Power steering is standard on the Electra models and available as optional equipment on all other series included in the exciting new line.

"BAKER'S DOZEN" COLOR CHOICE

Solid tone colors predominate this year. Thirteen colors are available. Two-tones will consist of Arctic white tops over a basic color. All exterior finish is the new "magic mirror" paint which will retain its luster for many years.

The 1959 Buick is a graceful, tastefully designed, powerful car. Everyone at Buick Motor Division is proud of Mr. Ragsdale's "new baby," and confident of high public acceptance. This could be the car that will kick 1959 off to a banner automotive year.

Here's the luxury "Electra" in the 2-door hardtop: 220.6" overall on 126.3" wheelbase; 401-cubic-inch V-8 engine, 10.5:1 compression ratio; power steering, "without loss of road feel," is standard.

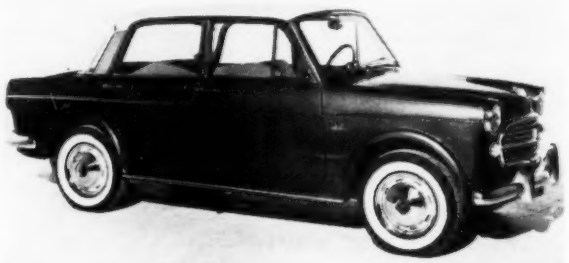
The small car in your future

Those "bugs" buzzing about major cities and over open roads, mean business—especially to smart service shop operators. Like their "bigger brothers," small cars need service . . . and like all motorists, their owners gladly repay understanding and competence with profitable repeat business.

By E. S. HARRIS
Field Editor

● BACK IN THE 30's, when Adolf Hilter began regaling his countrymen with promises of an economical family car to be known as the "Volkswagen," practically no one expected the spartan dream car he was describing to become an important factor in the United States automotive industry. After all, Hitler is recalled as the world's greatest recognized exponent of the "Big Lie."

And when the first model of his highly-touted midget reached this country, everyone nodded knowingly, laughed and remarked, "Wouldn't you know it . . . he fooled them again?". For this Volkswagen appeared in custody of Ordnance—it was a military vehicle comparable to the American Jeep, and had been captured on a World War II battlefield. No family car at all, it was slated for minute examination by Ordnance experts.



Fiat 1200 Sedan, 8-foot wheelbase, 55-h.p., one of many models marketed by a relative newcomer to the import sweepstakes.

PROMISING PRISONER

Published reports pointed-up the shortcomings of this "German Jeep" in comparison to our own four-wheel drive vehicle, and little more was heard of it. But our Ordnance engineers found much worth investigating in this automotive "casualty." Its synthetic rubber tires were superior to any we could compound at that time . . . the air-cooled, horizontally-opposed engine located over the independently-sprung rear wheels was surprisingly light and efficient, required no liquid coolant or anti-freeze and so eliminated leakage and supply problems in tactical operations.

Furthermore, the differential supplied power to the wheels in such manner that little slippage occurred on muddy terrain. If the little crate did finally bog down in mud, it weighed so little that its passengers could dismount and manhandle it back into the running. Torsion bars weighed little, and kept the chassis "clean" of projections. Our engineers agreed that this little "bug,"

Below—Best known of the "bugs," the American Model Volkswagen Sedan. Some 200,000 VW's now roll on U.S. roads and streets. At left—VW Kombi converted to Mobile Service School, such as operated continuously by each of the 14 U.S. distributors.

Borgward's sporty Isabella-Coupe (above) rounds out a range of compact family cars. Below, the increasingly familiar Consul, a leader in the extensive line of the Ford Import Division.

with its sedan type body just might be a practical promise, the exception to prove Adolf's rule so to speak.

Even so, they were not predicting popularity for this type of small car with the American public, which seemed inclined toward as much bulk in automobiles as the individual could afford. Midgets were for Europeans!

THE LONG SHADOW

As it turned out, the 'Volks' actually was the kind of signal covered in the old adage that "coming events throw their shadows before." As we all know now, the Volkswagen market in this country outstripped the export production capacity of the West German factory. Some dealers are reported actually importing used VW's to be sold at prices mighty close to those of new ones!

Not that the American small car appetite can be satisfied only by the Volkswagen—it is merely the car that pioneered the market. Following in considerable volume have come the Hillman Minx; Anglia, Consul and Prefect; Metropolitan and Rambler; Renault Dauphine; Simca Aronde; Fiat; DKW; Opel; Vauxhall Victor, and Volvo—among others in a parade of small "family" cars. Clustered about a $2,000 price tag, these fall into the category of the ubiquitous Volkswagen rather than the costlier sports cars of the less costly novelty vehicles in the import group.

Actually of course, the "invasion" of small cars was previewed in this country almost 30 years ago—long before discussions of 40 miles to the gallon and use of only half the allotted parking space became fashionable. Back in the early '30's, the English Austin made a stab at establishing a national dealer network; and did capture the fancy and dollars of a few depression-burned motorists with pioneering instincts. However the little Austins didn't go over in volume. American manufacturers apparently took this as an indication that our public wanted larger cars, and acted accordingly.

For many years thereafter, small cars seen in this country were few and far between. Usually they turned up in coastal cities, imported or brought back from European trips by novelty-conscious individuals.

Today there are few communities indeed where the "bugs" are not very much in evidence . . . as second cars or as the family's sole transportation.

FACTOR IN THE SERVICE MARKET

For some time now, service shop operators and mechanics have been watching the small cars grow in popularity, with interest and questions about the degree of market they represent. Is it worthwhile to "tool up" and study-up for this kind of work? The picture of the small car future is not entirely clear . . . and the public statements of importers and domestic manufacturers often cloud, rather than clear, the outlook.

With 200,000 Volkswagens alone rolling over our highways, and with imports and domestic production of small cars climbing every year . . . it seems logical that few service shops will fail to have regular customers bringing in small cars for servicing and repairs.

American Motor's Rambler, only U. S.-built small car, has made its manufacturer quite happy with the results of entering this field: a boost from 12th up to 7th place in domestic production during the first quarter of this year, and a consolidation of market position. And the Metropolitan, built in England by Austin for American Motors, has also been successful in sales.

Ford, whose English-built models have been imported for 10 years but have "caught on big" only recently, calls the interest in small cars a "sign of the times." It has added the sporty Taunus model to its line.

Predictions of a yearly market of 300,000 or so for small cars, also lend weight to the belief that there will be continued growth in service business garnered from this source. Those preparing to handle it needn't

(Continued on following page)

Below, the surprising 3-cylinder DKW. Right, the Swedish Volvo, reported sweeping the West as a family car with sports punch.

Small Cars . . . CONTINUED

be too nervous about any immediate drop in potential. Further, domestic automobile makers declare they cannot tool-up for small car production until assured of sales volume of more than 500,000 annually. On this basis, service shops that buy special tools to handle import work, can safely expect them to pay themselves out before domestic "bugs" take over—if that should come to pass.

ENTRY IS EASY

With England, Germany, Sweden, Italy and other countries pouring their small vehicles into the market, the uninitiated mechanic may think he'd find himself swamped with complications that would preclude making any money out of working on so many unfamiliar makes. But according to import car specialists, this need not be so. Simplicity and ease of servicing, they say, are the common denominators among these cars.

Any serviceman accustomed to the long reach and contortions involved in snaking a wrench into position on some of our vehicles, will be pleased to learn he can get the wrench where it belongs with half the struggle on a small car. Does it matter that the tool will have metric, instead of SAE markings?

In most cases, the same tool supplier that sold you your general purpose set for domestic cars can also provide you with the tools you need for import car work. Special tools developed for speeding and simplifying certain operations on the imports can often be obtained through the distributor. Generally speaking, the representatives of foreign car manufacturers recognize the value of helping service shops to acquire the tools and know-how required to do the right kind of a job on imported cars; and will provide assistance on request.

Since there is little doubt that the market for small cars is growing, and since their design and operating simplicity makes servicing practical for any experienced general mechanic, many shops will be developing this kind of business specifically. To give these readers the basic information needed, AUTOMOTIVE SERVICE DIGEST will present a series of Tech Know-How feature articles, covering specifications and approved service procedures for the most popular family-type import cars, in forthcoming issues.

WHEN CHANGING YOUR ADDRESS

Please notify us 5 weeks in advance. Supply us with both your old and new address, including address label from current issue if possible. Copies we mail to your old address will not be delivered by the Post Office unless you pay them extra postage. **Mail address changes to Circulation Dept. Automotive Service Digest, 900 South Wabash Ave., Chicago 5, Ill.**

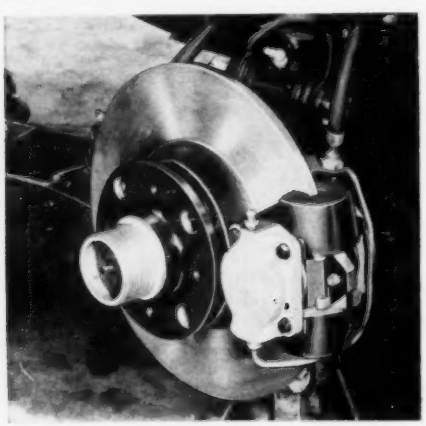
Two-Mile-A-Minute, 4-Cylinder MG Has Twin Overhead Cam, Disc Brakes

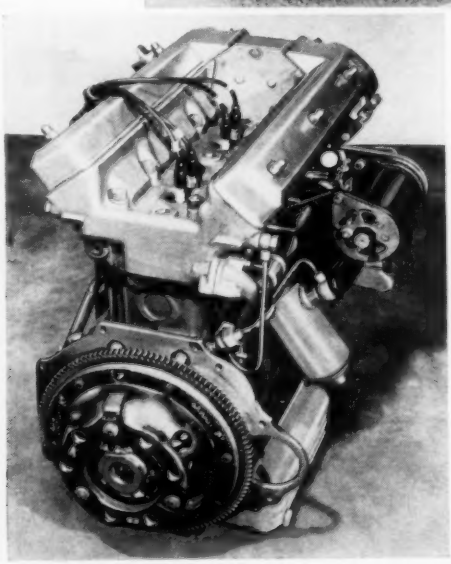
● A NEW TWIN camshaft version of the popular priced MGA, equipped with an all-new engine and disc brakes, has been announced by The M.G. Car Company, Ltd. The "Twin Cam" MGA will be produced in conservative quantities, and will not replace current MGA standard models.

The car is powered by a four-cylinder, twin overhead camshaft engine delivering 107 brake horsepower at 6,500 r.p.m. It accelerates from 0 to 120 m.p.h. in 38 seconds and is said to have a top speed in excess of 120 m.p.h. Disc brakes and knock-on disc wheels are standard equipment.

A streamlined and supercharged experimental version of the "Twin Cam" was driven by Sterling Moss at over 245 m.p.h. on the Bonneville Salt Flats last year.

Dunlop caliper-type, hydraulic disc brakes are used to give braking efficiency in keeping with car's acceleration and speed. Photo shows disc and caliper behind threaded knock-on wheel mount.





The Twin Cam, 4-cylinder MGA engine. Bore is 2.96875"; Stroke, 3.5"; compression ratio, 9.1:1; displacement, 96.906 cu. in.; brake h.p., 107 @ 6,500 r.p.m.

BELLWOOD, ILLINOIS

SACRAMENTO, CALIFORNIA

LINCOLNTON, NORTH CAROLINA

YONKERS, NEW YORK

SPRINGFIELD, MASSACHUSETTS

DETROIT, MICHIGAN

FARGO, NORTH DAKOTA

LAS VEGAS, NEVADA

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FAIRMONT, WEST VIRGINIA

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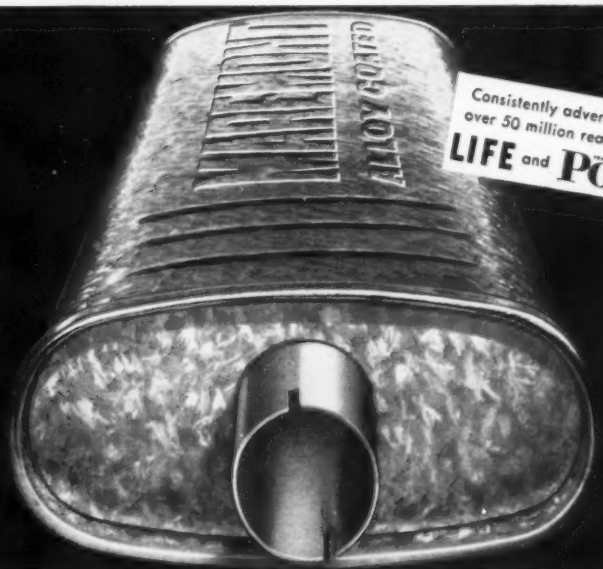

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"Souping up" engines to get more out of them than the manufacturers built into them is a highly specialized job which requires a thorough knowledge of basic engine theory and design, in addition to mechanical "know-how." Because of this, it will pay you to consider the following when . . .

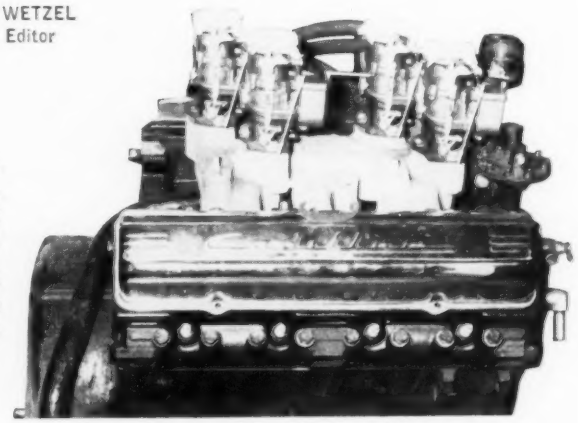
Modifying the stock engine

By GUY F. WETZEL
Technical Editor

● MANY MECHANICS know stock engines very well, but some do not have very much knowledge of basic engine theory or the technical aspect of engine design. Because of this, they can only *guess* at what to do in the way of adding carburetors, milled heads, special camshafts, porting, stroking, etc., should a customer ask them to "give it the works" to step up engine performance.

One who knows the theory behind "souping" procedures can often get much more for his money than one who is uninformed. All "souping up" jobs start with the stock engine, and what is gotten out of it depends on what is put into it, modified by the soundness of the various modifications and additions.

Up to the time of the introduction of the OHV Oldsmobile V-8, followed by the Ford, Chevrolet, Chrysler, and Cadillac OHV V-8's, the favorite of the "soupers" was the flat head Ford V-8. This engine was sturdy and dependable, and many types of equipment were added and various modifying operations were performed to obtain stepped up power.

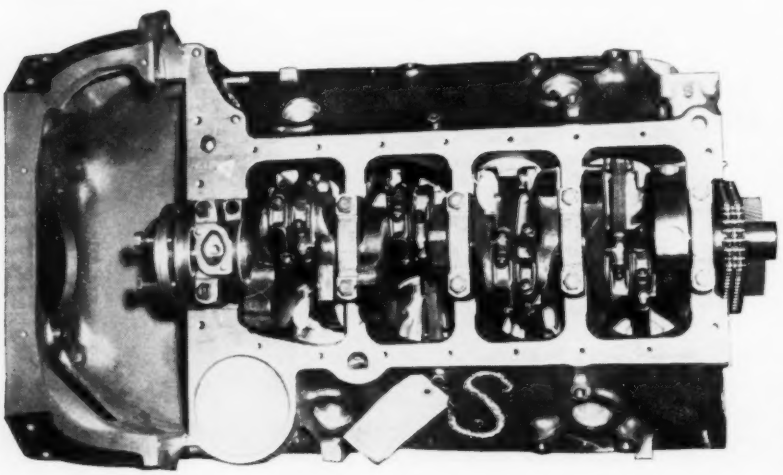


1954 Cadillac engine which was stroked ⅛", compression ratio raised to 10.5:1, fitted with roller tappets and special full race camshaft. Four, two-barrel carburetors are used on a special manifold.

Because of the number of factors involved, there are various degrees of souping procedures, depending on the objective the car owner has in mind. One authority, Roger Huntington, divides the amount of modification into four general classifications: (1) Conservative road engine; (2) Medium road engine; (3) Hot rod or track engine, and (4) Super competition conversion. There will naturally be some overlapping in these classes, but as we continue this discussion, the methods will be generally grouped in this way.

One fact that should be kept in mind by a prospective hot rodder is that the "disease" grows on you. Therefore, remember that if you set your goal at a modest conversion, it is not very practicable to change it to a hotter one. About all you can do is to peddle it to some one else and start over again.

Records are important. Make a note of all measurements, weights and tolerances. Don't overlook cost records, too. When the job is finished, make test runs, clocking the detailed performance, so you will have definite evidence of your accomplishments.



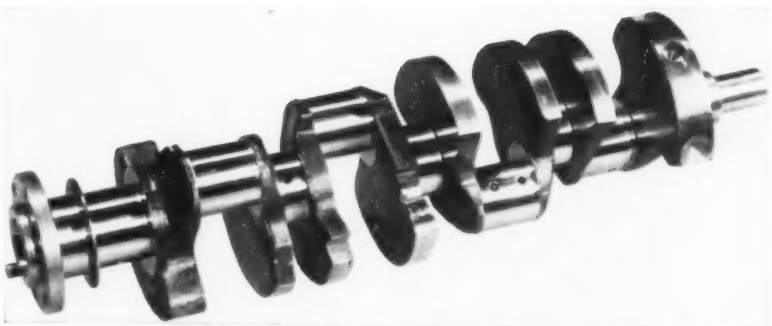
Chevrolet engine which has been fitted with a stroked crankshaft, special camshaft and roller tappets. The cylinders were bored out ⅛" oversize to accommodate oversize racing pistons.

POWER CONSIDERATIONS

The power developed by a gasoline engine depends on two prime factors—

torque and speed. Torque in turn depends on the mean effective pressure of the gases in the cylinder which exert pressure on the piston, the amount of explosive mixture drawn into the cylinder, and the compression ratio. The amount of A/F (air-fuel) mixture drawn into the cylinder is dependent on the cylinder displacement, with wide open throttle, and the volumetric efficiency.

Volumetric efficiency is the ratio of gas volume actually drawn into the engine cylinder, as compared to the piston displacement. Engine "breathing" is closely related to volumetric efficiency.



Crankshaft suitable for the 283 cu.in. Chevrolet engine, with stroke increased to 3½" by adding metal and regrinding the crank pins, as shown at left in drawing below. Notice how the added metal practically comes out to the end of the crank throws.

LEADING FACTORS

In view of the power considerations mentioned we can see that there are five logical basic factors leading to increased power. They are: (1) Increased piston displacement; (2) Increased mechanical efficiency; (3) Increased peak r.p.m.; (4) Increased amount of A/F mixture obtained by each cylinder on the intake stroke, and (5) Increased effectiveness of combustion.

There will be some overlapping of these factors, since changes in one may automatically affect one or more of the others. For example, increasing bore and stroke will increase the amount of gas mixture drawn into the cylinders, as well as increasing the piston displacement; or changes that reduce engine friction will increase peak r.p.m.

Five power factors are listed below, together with the more important operations that are done under each heading.

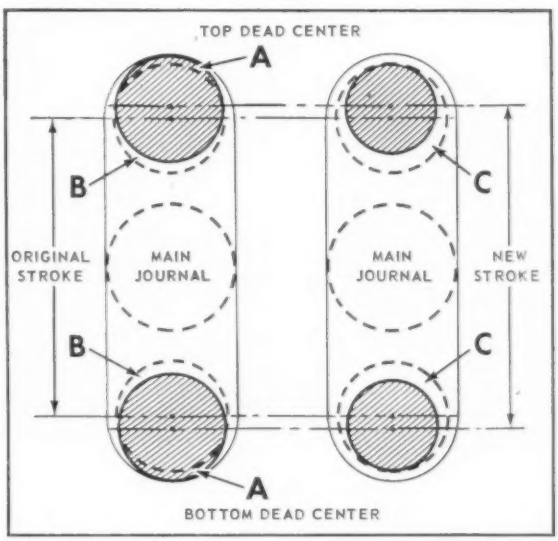


Diagram showing two different ways of stroking a crankshaft. Left: Metal has been added on the outside (A) and taken off on the inside (B), thereby keeping the journal same size. Right: Metal has been taken off the inside only (C), thereby reducing journal size.

1. Increase piston displacement
- a. Bore out cylinders.
- b. Increase length of stroke.

2. Increase mechanical efficiency
- a. See that bearings are in good condition, with no out-of-round journals or worn pins.
- b. Slightly increase piston and bearing clearances.
- c. Use the most suitable lubricant.
- d. Increase lubricant pressure.

3. Increase peak r.p.m.
- a. Have all pistons and rods weight balanced.
- b. Be sure that crankshaft is accurately balanced (if it has been changed in any way).
- c. Use the lightest possible reciprocating parts.
- d. Other factors mentioned affecting power will increase r.p.m.

4. Increase amount of A/F mixture per cylinder intake stroke
- a. Use modified camshaft with valve timing that will admit more gas.
- b. Use larger valves and/or higher valve lift.
- c. Increase carburetor throat area.
- d. Increase cross section area of manifold.
- e. Smooth path of gas flow in manifolds and ports.
- f. Supercharge.

5. Increase efficiency of combustion
- a. Increase compression ratio.
- b. Use correct ignition timing.
- c. Eliminate hot spots that could cause preignition.

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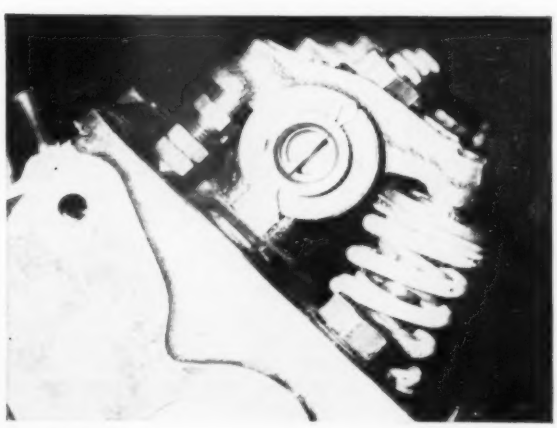
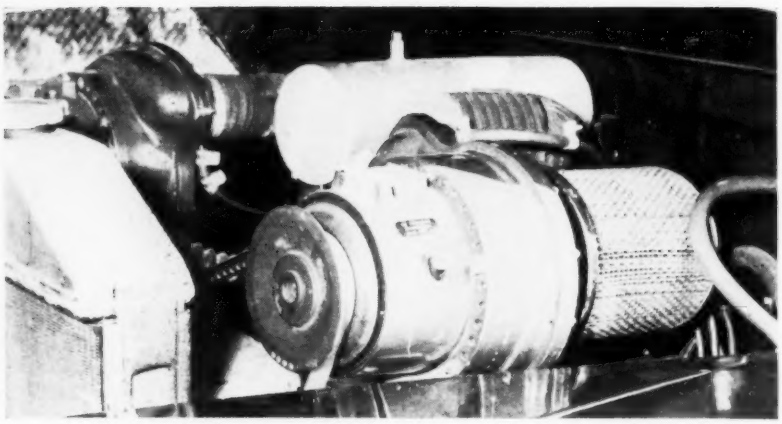


Detail of rocker arm and adjustable push rod on a modified engine. Where mechanical tappets are used and there is no adjustment on the rocker arms, adjustable push rods must be used.



A 1946 Ford Coupe fitted with two McCullough Superchargers supplying an Oldsmobile Rocket '55 engine.

Modifying . . . CONTINUED

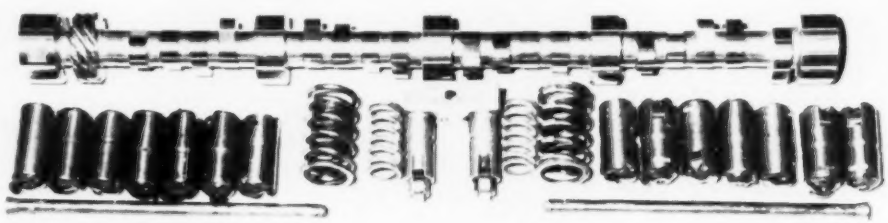
d. Be sure there is sufficient available ignition voltage.

e. Use sufficiently high octane fuel.

f. Have correct ignition advance throughout speed range.

g. Check carburetor to be sure A/F mixture is right at all throttle positions.

Set of parts for souping up Chevrolet engines. The camshaft is full race; tappets are of the mechanical roller type, using special compound springs and push rods. On some engines it is necessary to use adjustable push rods. Similar sets can be obtained for Cadillac, Olds, Chrysler and others.



INCREASING PISTON DISPLACEMENT

There are only two ways to increase piston displacement—by reboring the cylinders, or by "stroking."

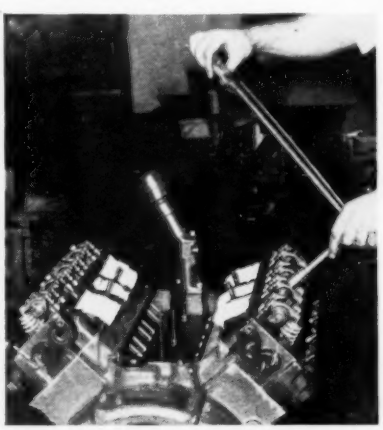
The simplest, most economical way is reboring the cylinder to increase the diameter 1/8" to 3/16". On a 3-7/8" diameter this would increase the displacement almost 7%, which, with a 320 cu.in. engine would step it up to approximately 342 cu.in. or the hp. up from 240 to approximately 258. The limit on safe reboring is about 3/32" on the radius; 3/16" on the diameter.

Reboring, of course, requires new over-size pistons and rings. This is one of the simplest and most economical ways of adding "soup" to an engine. It usually means removing the engine from the chassis, though on some cars the boring can be done with the engine left in place. If other work, as is usually the case, is to be done, it is better to pull the engine.

Stroking, for the benefit of those who may not be clear as to what this means, refers to increasing the crank throw to give a longer piston stroke. Until recently, this was done by grinding off metal on the inner portion of the crank pin journal without removing any from the outermost portion. A somewhat smaller crank pin diameter was formed, with its center line moved outward from 1/16" to 1/8", which increased the stroke from 1/8" to 1/4". However, this method had the disadvantage of materially weakening the crankshaft.

Now there is at least one concern located in California which specializes in adding metal to the outside of the crank pin by spraying, to replace the metal which is removed from the inner portion. This method eliminates the need for a reduced crank pin and permits the use of standard bearings in the lower end of the connecting rod. The company doing this work guarantees that the added metal will not peel or loosen, and reports on crankshafts in use have been favorable. The added metal appears to be free from porosity.

Assembling a modified Cadillac engine. Extreme care is used in every step of assembly, including the accurate torquing of all important points.



Adding 1/8" of material to the crank pin journals will increase the stroke 1/4". On a 3 1/2" stroke engine such an increase will amount to another 7%, stepping the cylinder displacement in the previous example up from 342 to approximately 366 cu.in. and horsepower up from 258 to 276. Thus the total gain from both boring and stroking amounts to 46 cu.in., in displacement and 36 hp. With the metal spraying method, the stroke can be stepped up to an added 3/8", if desired.

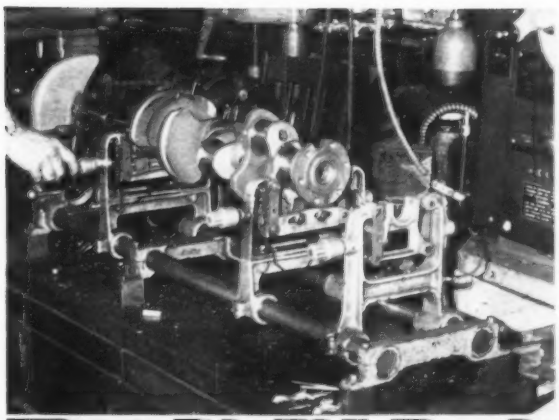
When the crankshaft is stroked, either appropriate pistons or rods must be used to keep the compression ratio at a suitable value. Care must also be used to see that there is no danger of the pistons striking the cylinder head, valves, or, at the other end, the crankshaft. The compression ratio can be raised or lowered by the pistons and rods that are used, and it can also be affected by the head, whether standard, truck, or special. The piston dimension from the center of the piston pin to the crown of the piston will determine the compression space with piston at TDC. It can readily be seen that unless the crank throw, connecting rod length and piston dimensions are all coordinated, that there will be trouble.

Stroking is expensive because it requires removing the crankshaft and shipping to the shop where the job will be done. In addition, there is the cost of new parts, and the labor to

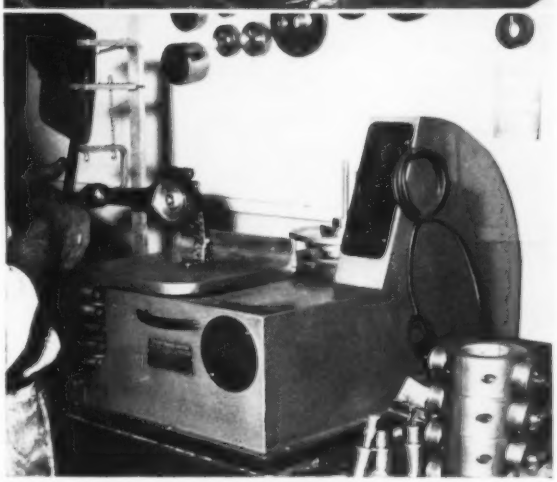
disassemble and reassemble the engine. This operation is not recommended for the conservative or medium souping jobs.

On jobs where maximum performance is demanded, the connecting rods will be carefully matched by weighing the big end and selecting those which have a minimum variation in weight. When an engine is speeded up to over 6,000 r.p.m., a weight variation which would be insignificant at 70 m.p.h. can be detrimental at speeds in excess of 100 m.p.h., or at high r.p.m.'s on rapid acceleration in gear.

The *flywheel* should be given some consideration if the hot rodder wants to get the most in acceleration ability from his souped up engine. The flywheel can be turned down to remove about half of its normal weight, which in turn reduces the inertia affect of the flywheel, making the engine respond more quickly.



All stroked or special crankshafts should be dynamically balanced before being put into the modified engine.



In assembling a souped up engine, it is necessary that the connecting rods be carefully matched as to weight. Here a special scale is being used to weigh the big end of a rod.

INCREASING MECHANICAL EFFICIENCY

To do anything about this, the engine will have to be taken down for inspection and possibly bearing replacement, unless the bearings are in very good condition. If new bearings are put in, the clearance should be increased from .001″ to .0015″, measured on the journal diameter.

It might be advisable to put a somewhat stronger spring on the oil pressure relief valve, to step up the oil pressure. Be sure to use a high grade lubricant that is most suitable for the kind of use the engine will be given. A new synthetic lubricant that will not form carbon and will stand up under excessive temperatures, is available for racing engines and hot rods that will be used under severe conditions.

All pistons and rods should be weight balanced, using the lightest possible parts. For racing service, use lightweight pistons specifically designed for this purpose.

Increased displacement, higher compression ratio, better breathing, etc., will affect maximum engine speed and result in higher peak r.p.m.

INCREASING A/F MIXTURE

Increasing the bore and stroke increases cylinder volume, which will naturally increase the amount of explosive mixture drawn into the cylinders on each intake stroke; though the increase may not be proportional, due to additional friction loss in flowing through the manifold and past the valves.

Using a different camshaft with three-quarter, semi-race, or full race cam forms will increase the A/F mixture amount by holding the valves open longer and opening them wider. For example, a special camshaft suitable for the 348 cu.in. Chevrolet, with full race cams, has this valve timing: In.Op. 20°BTC, In.Cl. 72°ABC, Ex.Op. 72°BBC, Ex.Cl. 26°ATC, giving a valve overlap of 52°.

This camshaft is designed to operate only with roller tappets in place of hydraulic tappets. The roller tappets, special valve springs and special push rods, with specially designed tappet housing retainers, are furnished in kit form for the 283 and 348 cu. in. Chev-

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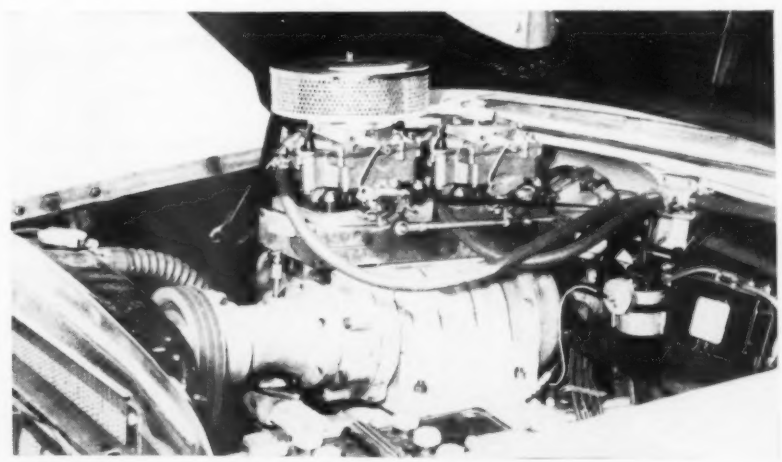

'56 Olds supercharged with a Roots type blower and two four-barrel carburetors. A large opening was cut in the hood to allow for the two carburetors and air cleaners

rolet engines. The special valve springs are considerably stronger than the standard springs and are required to prevent valve float at very high engine speeds. The cams are designed to give higher lift to the valves, which provides for increased gas flow.

Increasing the carburetor throat area can be done by using two four-barrel or three two-barrel carburetors. The manifolds designed for either of these carburetor arrangements have ample gas passages and have streamlined passages to give uniform gas distribution. The objection to larger manifolds on regular stock engines, that at low speed the air velocity is so low that it allows excessive dropping out of fuel, does not apply to souped up engines. This is because they idle much faster, and hot rodders know that they can't have the increased power and performance and still have a good idle at normal idling speed.

For maximum performance, valve ports are ground out and polished to minimize fluid friction of the gas flow.

SUPERCHARGERS

Supercharging is an imporant means of getting more power out of an engine. There are three general types of superchargers: (1) Centrifugal, which must be driven at six to ten times engine speed; (2) Roots type positive pressure blower which will turn at less than engine speed, and (3) Rotary vane type, which is a positive pressure air pump, and runs at less than engine speed.

A supercharger installation, properly designed, will supply air at six pounds or even higher, whereas atmospheric pressure is zero gauge pressure, or slightly less due to the drop in pressure through the air cleaner. On the basis of absolute pressure, atmospheric is 14.7 psi, while the pressure from a good supercharger will be over 20 psi (absolute). Disregarding friction this would mean an increase of over 40% in the amount of gas taken into the cylinders. While this provides considerable gain in horsepower, it is not all "gravy" as it takes a lot of power to drive the supercharger, though the net gain is worth while.

A supercharger installation will be quite expensive, as the equipment itself costs plenty, and the work of installing it is quite a job. The Automarine Specialists, of Chicago, have turned out some remarkable jobs. One of those illustrated has dual super-

THE MOST POPULAR TOOLS OF

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SIZE 5UT ½" DRIVE

This famous I-R nut runner gives you 25% more electric Impactool power. A real multi-purpose tool to ream, tap, drill—do any of 11 multi-purpose jobs. Available with exclusive optional Torsion Bar torque control . . . Ask your Ingersoll-Rand Jobber to demonstrate the amazing 5UT.

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ONLY INGERSOLL-RAND GIVES YOU
5 SIZES IN ELECTRIC IMPACTOOLS
8 SIZES IN AIR TOOLS

chargers on an Olds V-8 engine installed in a 1946 Ford coupe. Appearance wise this automobile looks like an ordinary, well kept vehicle—except that it will wind up close to 140 m.p.h.! Another one is a 1955 Ford T-Bird with a '55 Chrysler 300D engine. This has two blowers, feeding into a pressure box with two four-barrel carburetors. It has a modified engine and will travel in excess of 100 m.p.h.

Some of the engines with superchargers will have an effective compression ratio as high as 16 to 1, and require the use of special fuels.

INCREASING COMBUSTION EFFICIENCY

Increasing the compression is a well known way of increasing the useful energy that can be obtained by burning a combustible mixture of air and gasoline in engine cylinders. Our late model engines are already up to a compression ratio of 10.5:1, so it is doubtful whether much net gain can be obtained by raising it any higher; especially when considering the effect of engine deposits and the higher ignition voltage required. On some of the 1955 models, with compression ratios of around 8:1 or 8.5:1, it might pay to step it up a couple of numbers.

As previously stated, the compression ratio can be controlled by the piston design, but the length of the connecting rods, or by the cylinder head that is used.

The correct ignition timing has an important affect on the efficiency of combustion, as a spark that occurs too early can cause destructive and power wasting pre-ignition; while if it is too late, the normal explosion pressure is not built up. Also, it may present the problem of engine overheating. Therefore, one of the important tuning operations is setting the ignition timing very accurately.

Hot spots that may result from accumulations of carbon or lead, especially if there are any sharp projections, can be the cause of pre-ignition and detonation. These may be on the cylinder head, on a piston, or on a valve. Any appreciable amount of accumulations will also increase the compression ratio, possibly to a point where the fuel will not have sufficient octane value, and there will be detonation. The only sure way to get rid of hot spots is to remove the head and clean the combustion chamber.

To be sure that there is sufficient available voltage in the secondary circuit of the ignition system, each factor affecting this voltage must be in top condition. This means that the plugs must have the correct gap and

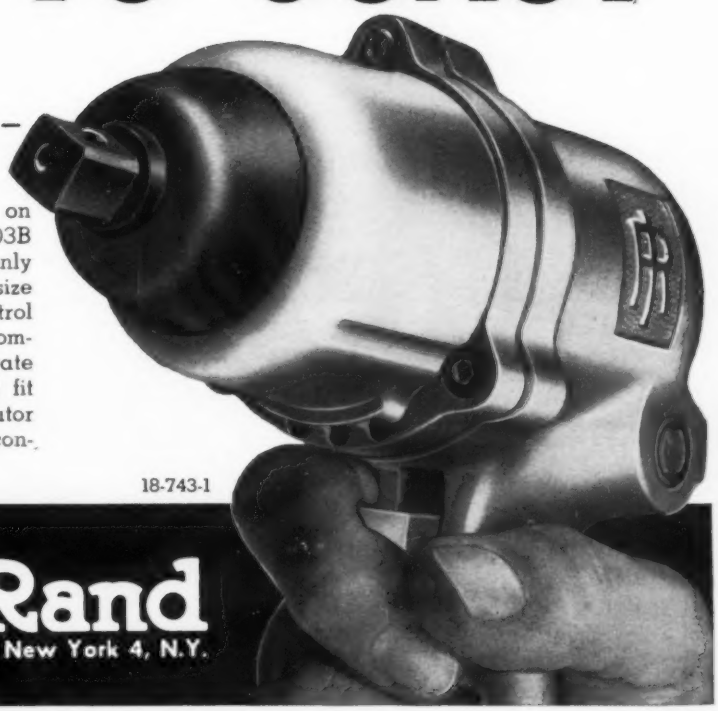
(Continued on page 71)

MECHANICS
COAST TO COAST

AIR

SIZE 403B ½" DRIVE

Handle all but the very largest nuts on cars and trucks with the lightweight 403B Impactool. The 403B—which weighs only 5 lbs.—is the most powerful tool of its size—a Select-Air regulator permits control for safe use on small jobs—an air compressor as small as 1½ hp will operate this tool. Compact design lets 403B fit into close quarter jobs, reduces operator fatigue. See your I-R Jobber for a convincing demonstration.



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Ingersoll-Rand
11 Broadway, New York 4, N.Y.

Servicing air conditioners

With the increasing number of cars being air-conditioned for passenger comfort, a profitable business of installing, testing and servicing the units awaits the shopman who understands how and what makes them work.

By ED PACKER
Member, S.A.E.

Part IV—Servicing the Chrysler Units

• SLIGHT, YET IMPORTANT operating and service changes have resulted from Chrysler's unitized construction of the car heating and cooling units mounted on the engine side of the firewall (Fig. 1).

Sealing the evaporator (that cools your customers) into a housing with the heater core cuts down chances of air leaks that could interfere materially with the efficiency of both the cooling and the heating action.

Before getting into actual service procedures, let's get acquainted with air movement through the combined air conditioning and heating installation. The entire action is well pictured in Fig. 2.

When removing or replacing either unit on the firewall, only one joint remains to be sealed. This is the seam between the flange of the unitized assembly and the dash panel or firewall. The engine side of the firewall with the unitized assembly removed is pictured in Fig. 3.

A service detail of importance when working in this area is to see that the plenum chamber drain openings are kept clear for proper drainage of condensate.

ANTI-FREEZE NEEDED

Anti-freeze must be used in the cooling system of any car that has a unitized air conditioner. The presence of the cold evaporator unit in the same housing with the heater coils could very likely freeze the heater coils unless the engine cooling system is protected down to at least 20°F.

Chrysler specifies a glycol base anti-freeze for use in the cooling system throughout the entire year. While protection to 20°F. is sufficient in Summer, the protection

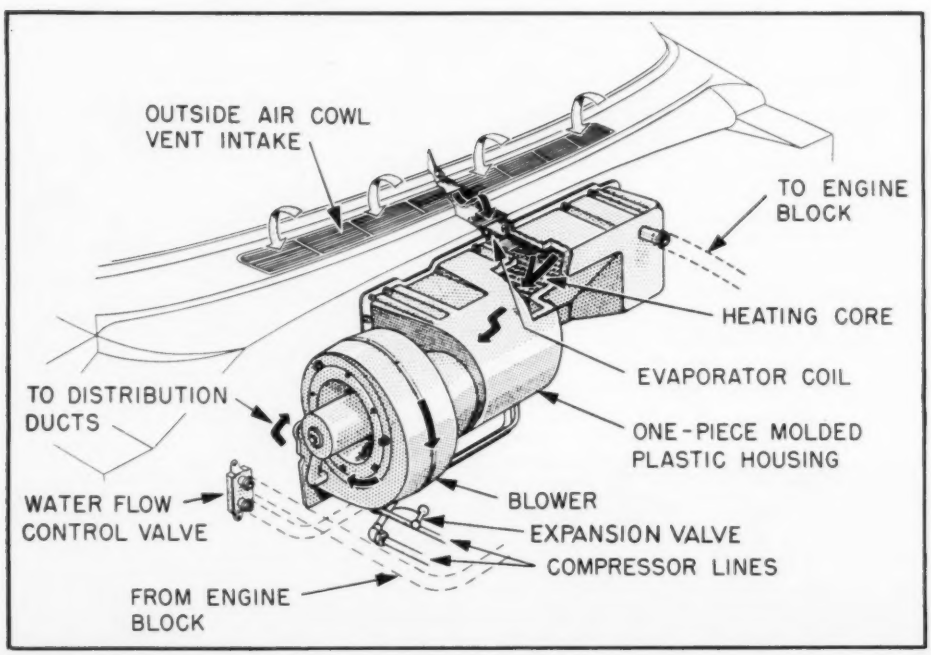

Fig. 1. Unitized heating and cooling unit. This assembly is on the engine side of the firewall, and first appeared on the 1957 cars.

must be increased, of course, according to the coldest weather expected in Winter.

WHAT EACH UNIT DOES

Troubleshooting and effective service requires knowing just what each component in an air conditioning system does—or is supposed to do.

A schematic diagram covering all principal units is seen in Fig. 4. So let's take "time out" to be sure that we understand each unit's job. Then it will be easier for you to explain to a customer why each test is necessary.

COMPRESSOR

The compressor (upper left corner of Fig. 4) circulates refrigerant through the system. It actually sucks gas under low pressure from the evaporator, compresses it, and sends this hot highly pressurized gas to the condenser out in front of the car's radiator.

The compressor quite evidently then must have the ability to deliver sufficient volume at necessary pressures under all operating conditions.

CONDENSER

The condenser, more or less like the car radiator, is a heat exchanger. At the condenser, heat from the compressed refrigerant gas is transferred to the outside air that is flowing through the condenser fins. By this process, the refrigerant is condensed or changed from a gas to a liquid.

RECEIVER—STRAINER—DRIER

This unit is really a high-pressure storage tank. It's where the liquid refrigerant from the condenser is held until needed by the system.

Filter packs above and below the drier strain out any foreign particles.

The chemical drier within this unit has a "big appetite" for any moisture present, and dries out the refrigerant. It's an interesting fact that the drier in a refrigeration system works exactly the opposite of the atmosphere in relation to moisture. The atmosphere can accept and hold more moisture as temperature goes higher, but condenses or releases the moisture at lower temperature. The drier, on the other hand, can absorb and retain much more moisture at lower temperature, and releases the moisture at higher temperature. This is important from the service standpoint, since a drier containing excessive moisture may let a system operate efficiently on a normally warm day, but can release enough moisture to cause an expansion valve to freeze up on a hot day.

EXPANSION VALVE

The expansion valve is a metering device. It controls the flow of refrigerant from the drier into the evaporator, so that the coils are never starved or flooded. This flow control is necessary in order to insure complete and continuous vaporization inside the coils, no matter what the operating conditions may be.

EVAPORATOR

The evaporator works like a radiator—only in reverse. It has many coils through which liquid refrigerant flows. Air is directed over these coils, and liquid refrigerant flowing inside the coils absorbs the heat from the air. As this heat is absorbed, the liquid within the evaporator changes to a gas, which in turn is sucked out by the compressor; and the cooling cycle is repeated.

CONTROLS

A magnetic clutch actuated by a thermal switch automatically connects and disconnects the compressor drive pulley. Thus the compressor operates or remains idle according to the demands placed on the air conditioning system.

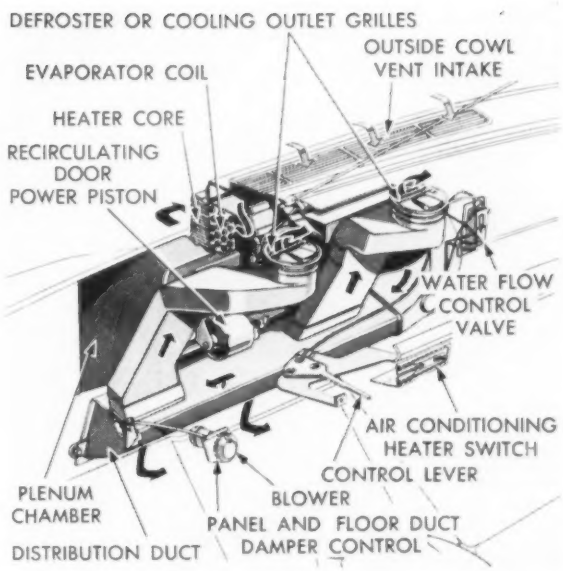

Fig. 2. Passenger compartment side of the unitized heater-air conditioning installation.

The thermal switch that controls the magnetic clutch gets its temperature signals from the evaporator.

Just before the evaporator gets so cold that it frosts over, the thermal switch opens the clutch circuit. This stops the compressor, which in turn stops the flow of refrigerant. As the evaporator warms up, the thermal switch closes the circuit and engages the clutch. Thus the compressor starts running and the system begins to operate again. Quite naturally complaints dealing with erratic operation would suggest that the thermal switch be tested.

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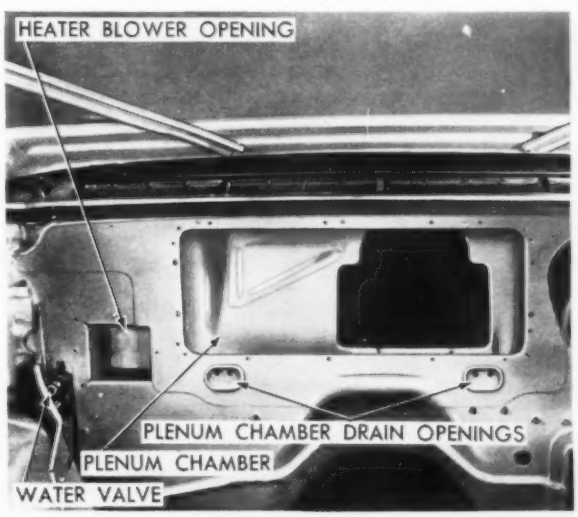
Fig. 3. Plenum chamber and drain openings as they appear on the engine side of the firewall when the unitized heater-air conditioner is removed.



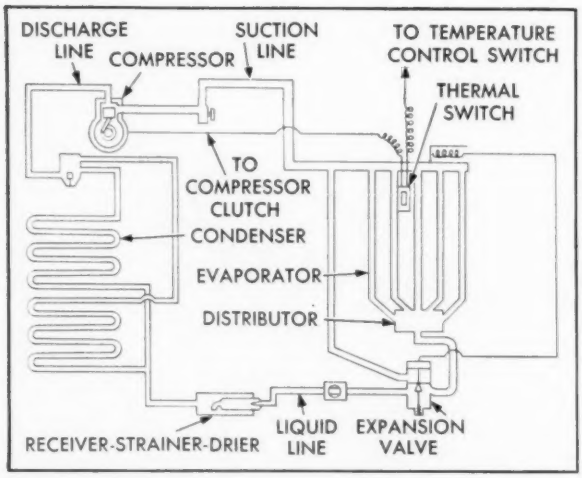


Fig. 4. Schematic diagram of the air conditioning system.

Air Conditioning . . . CONTINUED

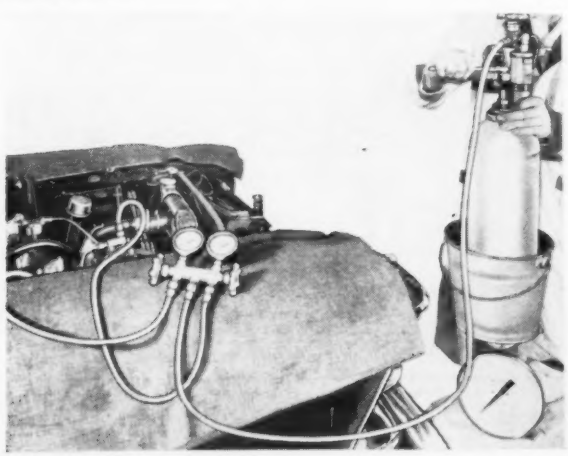
Tools, gauges and fittings for servicing Chrysler air conditioners are similar to those used for air conditioners of other makes, and many shops already have much of the equipment needed. The special tools shown in the accompanying illustrations are available from the Miller Mfg. Co. of Detroit, and most Chrysler product dealers have these tools, as well as air conditioner service parts. Therefore, it might pay shopmen to drop in and get acquainted with at least the air conditioning facilities of the Chrysler products dealer in their neighborhood.

One of the most essential items is the high pressure and low pressure gauge seen in Fig. 5, combined with the manifold that incorporates control valves and hose connections for attaching to the air conditioning system.

TROUBLE SHOOTING SUGGESTIONS

In connection with a complete analysis of the cause of trouble in an air conditioning system, the following will prove to be a valuable aid: *Warning: Always wear eye protecting goggles when opening refrigerant lines or servicing refrigerant-carrying components of an air conditioning system.*

Fig. 5. Hook-up of test gauges and manifold for recharging with Refrigerant-12.



CONDITION FOUND: Blower not operating	Blowers and compressor operating—No cooling	Blowers operating—Partial cooling	Low suction pressure and low head pressure	Suction pressure okeh and high head pressure	Low suction pressure—Head pressure okeh	LIKELY CAUSE
x						Defective lead wire
x						Defective motor
x						Defective switch
x						Loose connections
	x	x	x			Low refrigerant
	x	x	x		x	Moisture in system
	x		x			Restriction in strainer-drier
	x					Kinks in lines
	x					Dirty or defective expansion valve
		x	x			Leaks in system
	x	x	x			Compressor capacity insufficient
		x				Defective thermal switch
		x				Condenser lines kinked or obstructed
		x		x		Condenser air passages obstructed
		x				Temperature-pressure relation of refrigerant off (See chart below)
				x		Air in system
					x	Restricted receiver-strainer
				x		Too much refrigerant

TEMPERATURE-PRESSURE RELATIONSHIP OF REFRIGERANT-12

°F.	# Pressure	°F.	# Pressure
—40	11.0*	50	46.7
—35	8.3*	55	52.0
—30	5.5*	60	57.7
—25	2.3*	65	63.7
—20	0.6	70	70.1
—15	2.4	75	76.9
—10	4.5	80	84.1
— 5	6.8	85	91.7
— 0	9.2	90	99.6
5	11.8	95	108.1
10	14.7	100	116.9
15	17.7	105	126.2
20	21.1	110	136.0
25	24.6	115	146.5
30	28.5	120	157.1
32	30.1	125	167.5
35	32.6	130	179.0
40	37.0	140	204.5
45	41.7	150	232.0

* Inches of Vacuum

Experience indicates that a compressor operating on one cylinder will give good test indicator readings. At the same time it will not cool the car satisfactorily.

COMPRESSOR CAPACITY TEST

A special adapter or test cap has been made available to check the valve operation on air conditioning compressors. This cap has a calibrated bleed hole in it and is used to measure the amount of air pressure the com-

pressor maintains at a given engine speed.

To make a compressor capacity test, the following procedure is suggested:

1. Start engine and set idle at 1200 r.p.m. Engage compressor clutch. Turn blower switch on "High" and temperature control lever to "Cold" position. Open car windows.
2. Allow engine to operate until engine and compressor are up to normal operating temperature.
3. Reduce r.p.m. to normal idle and stop engine. Remove the valve stem protective caps from suction and discharge valves. Use ratchet wrench and back-seat both suction and discharge service valves by turning valves *counter-clockwise* all the way.
4. Remove service port caps from suction and discharge service valves and attach hoses from gauge set manifold (Fig. 6).

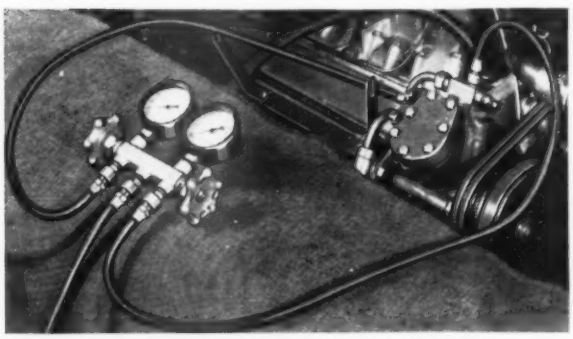


Fig. 6. How manifold and gauges are connected into system for performing tests.

5. Attach hose from compound gauge, on left of gauge assembly, to the suction service port. Attach hose from right gauge to discharge service port. Remove plug from the end of the center hose on the gauge.
6. Close both right and left hand shut-off valves on the manifold gauge set by turning them *clockwise*.
7. Start engine and with compressor engaged set idle to exactly 500 r.p.m.
8. With ratchet wrench, rotate valve stem of suction service valve *clockwise* until valve is completely front seated. Front seating the valve will cause the suction pressure to drop to zero, and from a zero reading to a vacuum reading, pumping down all the refrigerant out of the compressor.
9. With compound gauge reading 20 to 25 inches of vacuum, rotate the valve stem of the discharge service valve *clockwise* until the valve is completely front seated. Open the right hand shut off valve on the gauge set by turning it *counter-clockwise*. This will allow the small amount of gas trapped between the compressor and the discharge valve to vent down to zero through the center connection hose of the manifold gauge set.
10. Open left hand shut-off valve on manifold, remove hose from the center connection of gauge set.
11. Attach capacity test cap (Tool SP-2922) to center connection of gauge set. **Note:** The test cap must be absolutely clean before installation on the gauge. Wash it with solvent and blow dry. The test cap is meter drilled and wire or similar instrument should never be used to open the vented orifice.

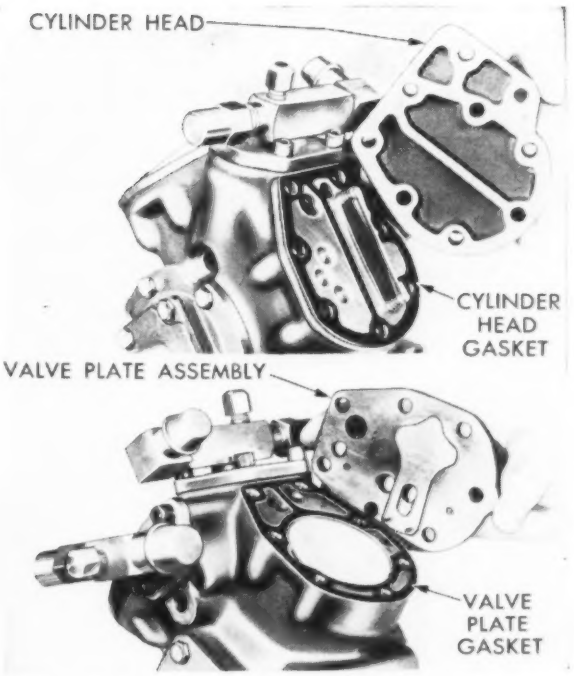


Fig. 7. Removing cylinder head to change valve plate assembly.

12. Disconnect the manifold hose from the suction service valve, leaving service port open.
13. Close the left hand shut-off valve on the manifold gauge. Note the pressure reading rise on the high pressure gauge.
14. Operating engine at exactly 500 r.p.m., the pressure reading on high gauge should read 190 to 210 p.s.i. To make sure reading on gauge is correct, open and close the left hand shut-off valve on the gauge set several times. If pressure readings rise on gauge and return to 190 to 210 p.s.i., the compressor is functioning satisfactorily. If pressure reading is below specifications and tachometer and gauge is reading accurately, stop engine and check compressor oil level, since low oil level will cause a low capacity test reading. The oil level should be between ¾" and 1½" dip-stick measurement.
15. Add oil to the compressor, if necessary, and recheck the compressor for capacity test readings. If compressor pressure is below the prescribed specifications, the compressor valve plate assembly should be replaced (Fig. 7).
16. After replacing the valve plate on a compressor, make a capacity test again to determine compressor pressure capacity. If compressor (with oil level corrected and valve plates replaced) does not come up to specified pressure, remove suction service valve from compressor.
17. Inspect suction screen (located in opening under valve) and see that it is clean, and that the gasket is properly seated. If screen is clean and gasket is not damaged, and compression test does not come

(Continued on following page)

up to specifications, the compressor should be replaced.

Note: When replacing a compressor, an adjustment must be made to compensate for the oil remaining in the system. Check and correct oil level in new compressor to the same level as oil in the old compressor. It should be approximately 1" to 1½". A ⅛" drill rod makes a satisfactory dipstick. Start engine and run for approximately 15 minutes and check oil level again. Add or subtract to maintain specified limit. This check can be made only after the system has been open to allow refrigerant and oil to circulate through the entire unit. Remove compressor vent cap from manifold gauge and wrap cap in clean cloth to protect orifice from dirt and grit.

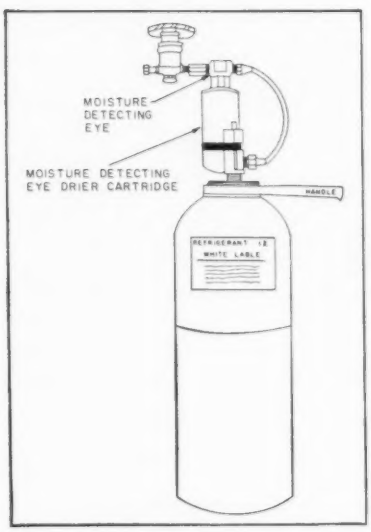


Fig. 8. Cylinder of refrigerant-12, showing moisture detecting eye and drier cartridge.

18. *Open* right hand shut-off valve on manifold gauge set and close left hand shut-off valve; connect suction hose to suction service port.
19. With engine running at 500 r.p.m. and compressor engaged, "pump down" the compressor by bleeding air out of the compressor through the center connection of the manifold gauge. When 25 to 28 reading is indicated on the vacuum gauge, turn suction service valve a fraction of a turn *counter-clockwise* for a few seconds and then front seat the valve. This will allow small amount of gas accumulated in suction line to flow into compressor and crankcase, mixing with and to be absorbed by the oil. This operation will also cause the gas to flow through the manifold gauge center connection.
20. Feel the center connection on the gauge. If no more gas is flowing, close right hand valve on gauge set.
21. Stop engine and turn both suction and discharge service valves *counter-clockwise* until they are completely back seated. After back-seating each valve, turn each valve one turn *clockwise* to operating test position.
22. Open both hand shut-off valves on manifold to release pressure on manifold gauge hoses.
23. Disconnect and remove hoses from both service valves.
24. Replace both valve stem and service port caps.
25. Adjust belts and check compressor brackets for tightness. Belt tension should allow ⅜" deflection under 9 to 12 lb. pull at center of longest span.

Whenever the air conditioning system is to be tested, purged of its refrigerant, evacuated of all moisture, or recharged, the gauge set with its manifold is attached as pictured in Fig. 6. The center connection or hose is left disconnected for discharging the system. It is connected to a source of refrigerant supply, as in Fig. 5, for recharging. For evacuating, the center hose is connected to a vacuum pump.

Discharging is necessary whenever the system is to be opened, as, for example, when removing and replacing some unit in the refrigerant circuit.

To discharge, turn the manifold gauge set discharge hand valve a fraction of a turn counter-clockwise to allow gas to escape. Opening the manifold discharge hand valve too much in order to more quickly discharge the system will draw compressor lubricant off with the gas.

As the pressure on the manifold discharge gauge drops near zero, open the manifold suction valve. After the service work has been completed, the system must be purged of its refrigerant, evacuated of all moisture, and then partially charged so that it can be tested for leaks before making the final charge.

Adjust the now familiar test torch so that it burns with a small flame. Move the test torch detector sniffer tube over all connections. When a leak is found, the flame in the burner will turn bright green. If the leak is large, the flame will turn from bright green to bright purple. Should the leak be at a flared connection, take a pair of wrenches and try tightening the connection. If the leak cannot be eliminated by tightening, the system must be again discharged, the connection or flare reseated or replaced, the system purged and evacuated, and again partially charged for retesting. If no leaks are found, add to the partial charge until the system is properly charged.

CHECKING CHARGE BY SIGHT

Many mechanics add refrigerant without weighing. Others use the scale method in Fig. 5 when the system has been totally discharged. They do this by carefully watching the scale, and shutting the tank valve off when the system has absorbed 2¾ lb.

A tank of refrigerant-12 is standing in a pail of warm water not exceeding 125°F. in order to increase the pressure within the tank. Where a partial charge is desired, as when testing for leaks, the tank is shut off when 100 lb. pressure is reached on the discharge pressure gauge.

The sight method is used by many mechanics. This requires running the engine at 1200 r.p.m. with the air conditioner set for maximum output.

Chrysler, with sound justification, urges the use of a moisture-detecting eye and moisture drier cartridge on the refrigerant-12 cylinder, as in Fig. 8. Thus hooked up, now open the suction valve on the gauge manifold slightly (counter-clockwise). Control refrigerant entering the system with this valve. Do not allow suction pressure to exceed 60 p.s.i. Watch the sight glass carefully; the moment the sight glass is clear of bubbles, close the gauge manifold valve (clockwise).

Stopping the flow of refrigerant into the system as soon as the sight glass is clear, that is free of bubbles, is important. Too much refrigerant in the system can cause damage.

Now operate the air conditioner for 5 minutes, and again observe the sight glass for the presence of bubbles. If there is still evidence of bubbles, continue to charge

the system carefully until the sight glass is clear. Then repeat the 5 minute run. Where no bubbles are present after 5 minutes of operation, charge the system with an additional "shot" of refrigerant for 19 seconds. That will be just about right for all practical purposes. Close the tank valve and loosen the hose connections at the tank to allow the gas to escape gradually. Remove the hose after the gas has escaped. Back seat the suction and discharge service valves (counter-clockwise). Now remove the gauge manifold, and install service valve and service port protective caps.

MANY TYPES OF FAILURE

Moisture in any air conditioning system causes failure in many ways. Moisture may enter the air conditioning system if the system is left open during repairs. It also comes from condensation in replacement tubing, leaky seal caps, wet driers, unsealed charging hose or manifold, or the use of wet oil or refrigerant. Charging the system without the drier pictured in Fig. 8 is another way that moisture gets in.

Refrigerant-12 plus excess moisture equals freeze-up at expansion valve. Refrigerant-12 plus moisture equals hydrochloric and hydrofluoric acid. Such acid plus metals and refrigerant oil equals corrosive sludge, which causes stuck or sticky expansion valves. And corrosive sludge also clogs screens and strainers. All told there's probably nothing more destructive in any air conditioning system than an excess of moisture.

Used drier cartridges can be reactivated when saturated with moisture, provided refrigerant oil has not flowed through the drier. To dry the cartridge, unseal it and place it in an oven. Keep it in the oven for two hours at 300°F., or 1½ hours at 400°F., or 1 hour at 500°F.

CHECKING SYSTEM FOR MOISTURE

With copper tubing, sight glass, moisture detecting eye and cap made up into an assembly, as shown in Fig. 9, remove valve caps from suction and discharge service valves, back-seat and fully open (counter-clockwise) both valves. Remove caps from valve service ports and attach tubing and flare fitting assembly to the valve service ports.

Fill a container with *cold* water to allow for submersion of coil in water, as shown in Fig. 10. Turn valve stem of discharge service valve two turns clockwise. Purge air from tubing by *slowly* loosening up the tubing nut at suction service valve. After all the air has been bled from tubing, retighten nut. Test all the connections for leaks. Start engine and adjust engine speed to 1200 r.p.m. Open car windows and move the Air Conditioning operating lever to "Cold" position, and blower switch to "High."

Slowly turn the valve stem of the suction service valve clockwise two full turns, and check sight glass for flow of refrigerant liquid through glass. After approximately 15 to 20 minutes of engine operation (with liquid flowing through the moisture detecting eye) if the dot of the eye shows *pink*, excessive moisture is present in system.

If system is "dry" or contains a minimum of moisture, the dot of eye will slowly change to *light* blue. When dry eye shows a *dark* blue the same color as corresponds to the dot on eye, it is indicative that system is ready for safe, satisfactory operation. *If moisture detecting eye shows pink, excessive moisture is present. Light blue will indicate the system is border line, and moisture content should be lowered.*

To remove the moisture detecting eye and tubing assembly, proceed as follows:

With air conditioning system operating, back-seat first the discharge service valve, and then suction service valve

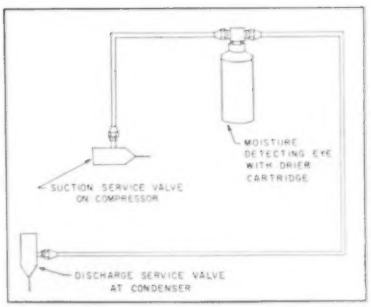

MOISTURE DETECTING EYE WITH DRIER CARTRIDGE
SUCTION SERVICE VALVE ON COMPRESSOR
DISCHARGE SERVICE VALVE AT CONDENSER

Fig. 9. How moisture detecting eye with drier cartridge is hooked into system to remove moisture.

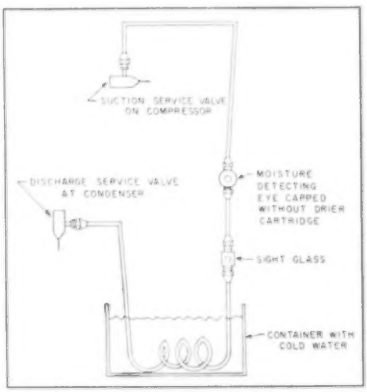

SUCTION SERVICE VALVE ON COMPRESSOR
DISCHARGE SERVICE VALVE AT CONDENSER
MOISTURE DETECTING EYE CAPPED WITHOUT DRIER CARTRIDGE
SIGHT GLASS
CONTAINER WITH COLD WATER

Fig. 10. Moisture detecting eye installed and operating.

counter-clockwise and stop engine. Remove tubing coil, sight glass, moisture detecting eye and cap assembly from suction and discharge service valves. *Install protective plugs in end of tubing fitting to keep moisture and other foreign matter from entering tubing.*

CORRECTING A WET SYSTEM WITHOUT DISCHARGING

With tubing, 30 cubic inch drier cartridge, and detecting eye made up into an assembly, proceed as follows:

1. Remove valve stem caps from suction and discharge service valves and fully back-seat (counter-clockwise) both valves.
2. Remove caps from valve service ports.
3. Remove flare plugs from tubing and drier cartridge assembly and attach flare nuts or tubing to service nuts of tubing to service valves. *Elevate drier and cartridge assembly above compressor height to facilitate absorption.*
4. Turn valve stem of discharge service valve two turns clockwise, and slowly loosen tubing nut at suction service port.
5. Purge air from tubing and drier. *Retighten tubing nut after* purging air.
6. Test all connections for leaks and correct if needed.
7. Turn valve stem of suction service valve two turns clockwise. *With the vehicle located in an area where the air conditioning system can maintain room temperature, allow vehicle to set for approximately 24 hours, or for sufficient time to allow the drier to absorb sufficient moisture.*

   When detecting eye has turned a *deep blue,* matching the comparison color dot on the dry eye unit, the system is sufficiently dry to permit satisfactory air conditioning operation.

   The chemical action, involving a change from a moisture-laden refrigerant to non-moisture refrigerant, is as follows:

(Continued on page 70)

By GUY F. WETZEL
Technical Editor

Compression tests—true or false?

Many a mechanic has been led astray by his interpretation of a compression test . . . but when supplemented with the cylinder leakage test, tough cases of poor engine performance are quickly and accurately analyzed.

• TO MAKE AN ENGINE run, three factors are normally considered as necessities: compression . . . carburetion . . . ignition. To these, two others can be logically added—fuel supply, and electrical systems. It is true that an engine will run if it has compression, carburetion and ignition, but if there is not an adequate and dependable fuel supply, together with the proper functioning of the generating, starting, and wiring systems, the power plant will not run very long, or very well.

One of the tests which is not made as often as it should be, but which should be made on every tune up job, is testing the compression.

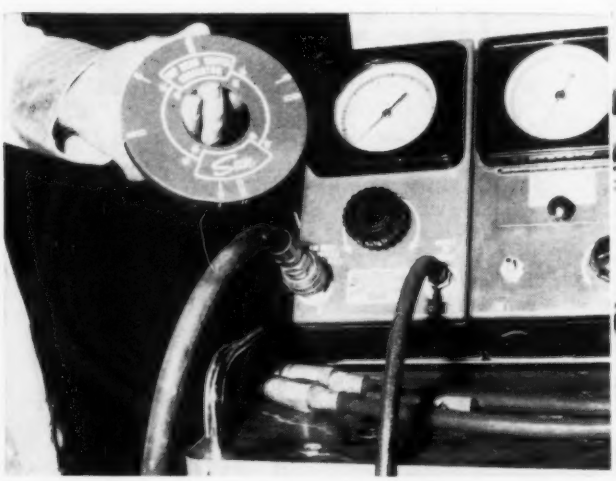
When one speaks of testing the compression, the first thing that comes to mind, in most cases, is the use of the time-honored compression tester. This instrument does give a certain amount of information about the condition of an engine, but its indications can sometimes fool the one making the test.

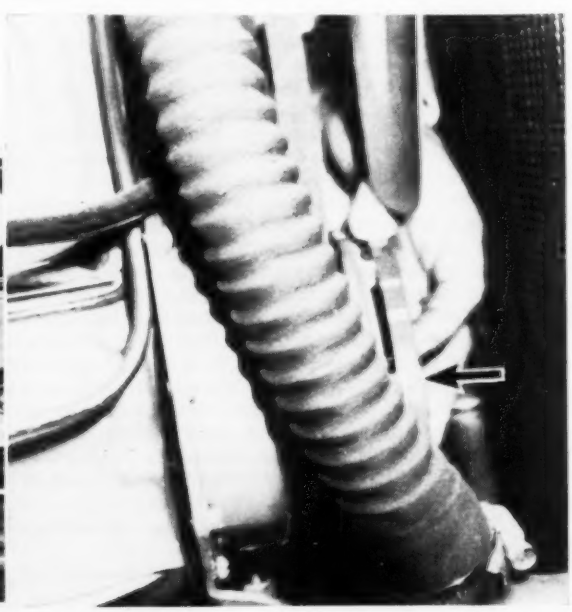
For example, a 1957 Pontiac was taken to a shop for a tune-up, but after new plugs, new points and condenser were installed and the carburetor adjusted, there was still a miss at idle that could not be tuned out. The owner took the car to another shop where the work of the first shop was checked and found to be good, as far as it went. The compression was checked and found to be between 150 and 165 p.s.i. in all cylinders, so it couldn't be the compression—or could it?

Finally the motorist took it to a shop which had a reputation for scientific testing, and there they checked the cylinders with a cylinder leakage tester. It was found that No. 5 cylinder had a leakage of 42%, with the other cylinders varying from 15% to 30%. The high leakage was past the rings, so that a valve job would not have helped the situation.

One of the well known carbon solvents was added to the engine oil and the owner was advised to take the car out on the highway and drive it at over 60 m.p.h. for at least 20 miles, and then bring it back to the shop. A few

The cylinder leakage tester (CLT) is shown at left on test stand in illustration below. The round disc being held by the mechanic has powerful Alnico magnets which hold it to the crankshaft fan pulley or dynamic balancer (as shown in illustration at right) to indicate when pistons are at TDC.





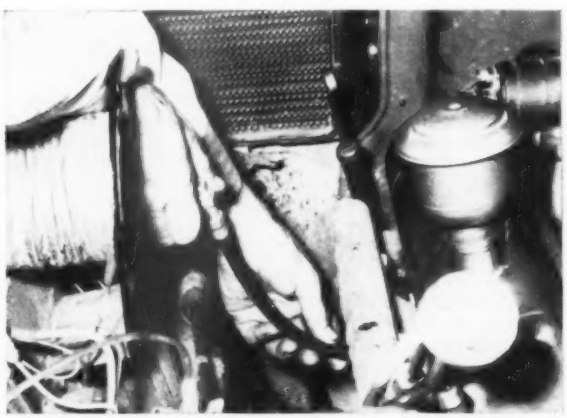
days later it was brought in, and after a minor carburetor adjustment, the engine idled beautifully at specified speed. Apparently the rings were somewhat carboned up from slow speed, stop-and-go city driving and the prescribed treatment cleaned up the carbon enough to get the leaking cylinder down to under 20%, with the rest of them under 15%.

The statement that indications of the compression tester can fool a man will bring up the question: "If you can't depend on the compression tester, what can you use that is better?" As you may have guessed by this time, the answer is: "the cylinder leakage tester, often referred to as the CLT for short."

LEAKAGE TESTER NOT NEW

This instrument is not new, but valuable as it is, it is not used nearly as much as it should be. And why should it be used is a logical question which deserves a logical answer. The compression tester measures a transient condition in which brief pressure impulses under only about one fourth of the explosion pressure are registered in a cumulative manner by each of four or five compression strokes forcing air under pressure past the instrument check valve.

The cylinder leakage tester measures the leakage under static conditions which allow time enough for leakage



The connector that goes into the spark plug hole is about 15" long and is screwed in by hand. A quick-connect coupling attaches to the instrument hose.

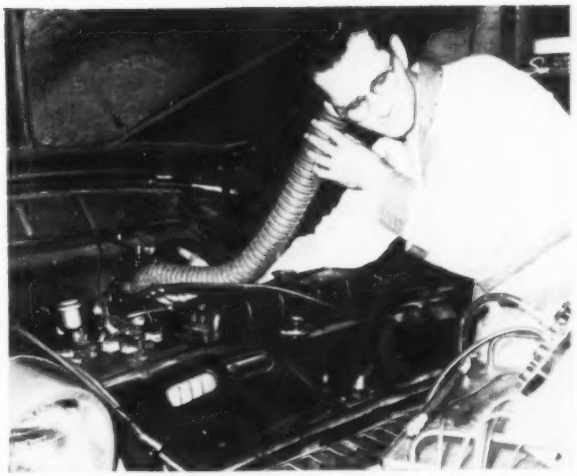
paths to be clearly indicated. It has the added advantage of indicating the leakage paths, whether past the intake valve, the exhaust valve, the rings, or a leaking head gasket.

It is generally considered that variations in compression pressure of over 20 p.s.i. from the highest to the lowest indicates the need for valve work or a ring job. The old stunt of putting engine oil in the cylinder to seal the rings temporarily, will tell to certain extent whether the leakage is principally past the rings or the valves, but this test is not nearly as dependable as the leakage test.

SOME CONCRETE EXAMPLES

Some concrete examples of tests with the CLT should be of interest. A shop where they were interested in getting an actual comparison of compression tests and CLT tests, made a series of checks on fifteen different engines, and the interesting results are given in a chart elsewhere in this article.

It has been found that cylinder leakage under 30% is not too serious, and generally will allow an engine to idle



With pressure on the cylinder, operator listens at the carburetor with length of heater hose for sounds of leakage past the intake valve.

with reasonable smoothness, and have good performance, with satisfactory fuel mileage, considering the kind of use the automobile is given. Over 30%, however, begins to get into the questionable zone.

The percentage scale is somewhat arbitrary, so that 30% leakage, as indicated does not necessarily mean that 30% of the compressed gases in the cylinder under operating conditions, will be lost. The indicating instrument is a sensitive pressure gauge, which measures the relative pressure in the engine cylinder built up by compressed air at a controlled pressure passing through a carefully calibrated orifice which is quite small. If the leakage past the rings or valves is greater than the rate of air flow through the orifice, the pressure will drop, and the meter will indicate a percentage which is called the percent of leakage. Regardless of the actual proportion of compressed gases lost due to leakage, the indications of the CLT are valuable and informative. Use of the instrument will avoid doing useless valve jobs, and also show where ring and/or valve work *are* needed.

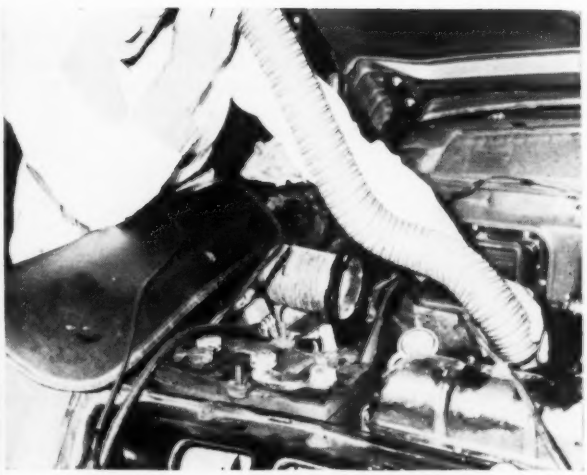
A SALES TOOL EASY TO USE

Some tune-up operators make it a practice to use the CLT on each tune-up job they perform. This gives an accurate picture of cylinder, ring and valve condition. If valve and/or ring work is indicated, it means a job for the shop. The test results are easily reproducible so that the need for mechanical work can readily be demonstrated to a customer. This will remove any doubt in his mind about the condition, since he can see for himself what the instrument shows. It is obvious that an engine with leaking valves or rings cannot be tuned properly, regardless of how perfect the work may be otherwise.

The CLT has been improved so that it is now very easy to use. One of the early problems was getting the piston on TDC on the compression stroke. There are two means that have been perfected to make this accurate and easy. One is to use a whistle, furnished with the instrument, which will blow as the piston comes up, and indicate by its change of tone when the piston is in the right position. The other way is a 6" flanged disc, painted a bright red color for easy visibility, and fitted with powerful permanent Alnico magnets. The disc is placed on the crankshaft fan pulley or dynamic balancer, and held in place by the magnets. On the flange there are marks every 90° and also every 120°, from TDC No. 1, so that

(Continued on following page)

Using his length of heater hose, the mechanic listens at the tail pipe for sounds of air leaking past the exhaust valve . . .



. . . while here he uses his "sounding tube" at the oil filler tube to detect air leaking past rings into the crankcase.

Compression Tests . . . CONTINUED

when the piston is on TDC for No. 1 cylinder, rotating the crank just 120° on a "6" or 90° on a V-8 will definitely put the following pistons in TDC position in their firing order, one after the other.

Using the remote starter control it is easy to turn the crank just enough for taking the next reading. Getting the indication is only a matter of seconds after the connection to the spark plug hole is made, and the piston correctly located. Connecting to the spark plug hole can be done by hand without the use of tools because of the soft rubber gasket at the threaded spark-plug-hole-insert.

With the air pressure applied to a cylinder, the meter indication is noted. If the reading should be over 10-15%, the operator will listen at the carburetor with the air cleaner removed for the sound of leaks past the intake valve, at the tail pipe for leaks past the exhaust valve, and at the oil filler pipe for leaks past the rings. If there should be leaks past the head gasket into the water jacket, listening at the radiator filler pipe will detect them readily.

TEST PROCEDURE

The detailed procedure to be followed when making the cylinder leakage test is this: After the spark plugs are removed, calibrate the instrument. Use the whistle connected into No. 1 cylinder to locate No. 1 piston on TDC position. Remove the whistle and connect the instrument to the cylinder. Apply the air pressure to the instrument and read the leakage on the meter. If the new indicating disc can be used on the car under test, apply it to the end of the crankshaft, with No. 1 TDC mark directly up, or opposite the pointer. The disc can be used on most engines, though on some the fan comes too close to the fan pulley or dynamic balancer so there is not sufficient room for it. With the disc in place, use the remote starter control to turn the crankshaft 90° (on a V-8) or 120° (on a "6"), which will put the next cylinder in the firing order, in position. Make the test, then repeat on the rest of the cylinders, following the firing order.

FIRING ORDERS

If the disc cannot be used, then the whistle must be used, in which case it is not necessary to follow the firing order, though care should be exercised to be sure the cylinders are numbered on the report the same as they are on the engine. Remember that on Ford V-8's the No. 1 cylinder is front right, and the cylinders are numbered 1, 2, 3, 4 (right bank), 5, 6, 7, 8 (left bank). Buick has No. 1 cylinder right front, and cylinders are numbered 1, 3, 5, 7 (right bank), 2, 4, 6, 8 (left bank). All other V-8's have No. 1 cylinder left front, with the cylinders numbered 1, 3, 5, 7 (left bank), and 2, 4, 6, 8 (right bank). Actually there are only two firing orders used on the current V-8 engines, but due to the three different cylinder numbering plans there are five apparently different firing orders used; two for Ford engines, one for Buick, one for Olds, and one used by all other V-8's. Therefore, unless you have a remarkable memory for figures, it is not very practical to try to remember the firing order for each engine. In most cases the firing order will be cast into either a cylinder head or manifold. All of the American six cylinder engines in current use have the same firing order, 1, 5, 3, 6, 2, 4.

It apparently takes a long time for a new testing method or instrument to be widely accepted and adopted. The CLT should be in every shop where tune-up or engine work is done, and eventually most shops will include it in their equipment. In the meantime, a lot of valve jobs that should be done will go on wasting gasoline and giving their owners poor performance.

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Compression Gauge vs. Cylinder Leakage Tester

CHEVROLET SIX (1955)—32,000 MILES

Cylinders	1	5	3	6	2	4
Gauge Test Figs.	135	145	140	140	140	145
Cyl. Leak Tester Figs. (in %)	25	20	26	20	25	22

Indicates an engine in good shape, but notice that compression pressure does not necessarily follow the leakage percent.

CHEVROLET SIX (1952)—69,500 MILES

Cylinders	1	5	3	6	2	4
Gauge Test Figs.	130	135	140	95	134	130
Cyl. Leak Tester Figs. (in %)	22	18	10	76	15	20

No. 6 cylinder obviously in bad shape. The CLT test showed it due to exhaust valve. Cylinder No. 4 also showed excessive leakage past exhaust valve, but not nearly as much as in No. 6.

FORD V-8 (1956)—18,320 MILES

Cylinders	1	5	4	8	6	3	7	2
Gauge Test Figs.	150	160	155	150	145	145	150	150
Cyl. Leak Tester Figs. (in %)	25	18	15	20	20	20	18	22

Engine is in good condition. Although there is a maximum variation of 15 p.s.i. in compression, there is only 2% difference between the highest and lowest compression, and on cylinders with the same compression there is a difference of 7% (No.'s 7 and 1).

MERCURY (1951)—41,000 MILES

Cylinders	1	5	4	8	6	3	7	2
Gauge Test Figs.	130	125	120	130	125	115	125	125
Cyl. Leak Tester Figs. (in %)	14	14	10	8	12	12	14	10

Engine is in good condition, but notice inconsistency between compression readings and CLT indications—showing a variation due to different proportions of leakage past rings and valves in different cylinders.

FORD SIX (1958)—2,500 MILES

Cylinders	1	5	3	6	2	4
Gauge Test Figs.	155	170	165	165	165	165
Cyl. Leak Tester Figs. (in %)	18	8	18	6	6	44

Almost a new engine, yet notice the 44% leakage on No. 4 cylinder with compression pressure of 165. On cylinders 5, 3 and 2 leakage was first indicated as 45-50%. Turning crankshaft 10° brought reading to lower values shown. This indicates that apparently the rings must have tipped a little on upstroke, and with a little further rotation of the crank, they seated and sealed as they should.

CHEVROLET V-8 (1956)—20,000 MILES

Cylinders	1	8	4	3	6	5	7	2
Gauge Test Figs.	125	150	140	140	140	135	135	135
Cyl. Leak Tester Figs. (in %)	30	16	26	17	28	14	18	20

Here there is more variation in leakage than in compression figures, but engine would not need valve or ring work.

FORD V-8 (1957)—15,100 MILES

Cylinders	1	5	4	8	6	3	7	2
Gauge Test Figs.	160	160	155	155	145	155	155	150
Cyl. Leak Tester Figs. (in %)	18	22	14	21	22	14	25	20

As engine was being checked for leakage, No. 1 cylinder first read 50%; then there was a loud snap and reading dropped to 18%. On No. 6 the initial reading was 62%, then when crankshaft was rotated 2° it dropped to 22%, apparently indicating that rings were cocked a little and snapped into proper sealing position. It is hard to say what effect this will have on engine operation, but it will not be beneficial.

FORD V-8 (1953)—41,281 MILES

Cylinders	1	5	4	8	6	3	7	2
Gauge Test Figs.	105	110	100	90	90	95	100	95
Cyl. Leak Tester Figs. (in %)	24	20	24	30	35	30	25	38

These pressures, while low, are consistent. Intake valves on last five cylinders need attention, however, as shown by the leakage test while listening at carburetor.

PLYMOUTH SIX (1949)—67,700 MILES

Cylinders	1	5	3	6	2	4
Gauge Test Figs.	120	120	110	105	100	120
Cyl. Leak Tester Figs. (in %)	11	35	49	48	80	30

Judging from compression figures, engine would not be considered too bad. Leakage figures, however, tell us that the rings on No. 5 and intake valves on last four cylinders are quite bad.

CHEVROLET V-8 (1955)—36,290 MILES

Cylinders	1	8	4	3	6	5	7	2
Gauge Test Figs.	150	160	170	160	160	165	150	140
Cyl. Leak Tester Figs. (in %)	30	30	32	18	18	34	25	34

Notice here that No. 3 and No. 6 cylinders have lower compression than No's. 4 and 5, yet have lower cylinder leakage. No. 4, with 170 p.s.i. has only 2% less leakage than No. 2 with 140 p.s.i. and 34%.

FORD V-8 (1958)—4,487 MILES

Cylinders	1	5	4	2	6	3	7	8
Gauge Test Figs.	170	170	170	165	175	150	170	170
Cyl. Leak Tester Figs. (in %)	11	15	10	14	8	10	11	8

Of interest is that on this almost new engine, one cylinder has compression 20 p.s.i. less than most of the others, yet shows less leakage than three of the cylinders with 20 p.s.i. more compression pressure.

FORD SIX (1954)—16,809 MILES

Cylinders	1	5	3	6	2	4
Gauge Test Figs.	120	130	130	130	130	130
Cyl. Leak Tester Figs. (in %)	35	30	31	28	16	26

Compression unusually uniform, except on No. 1, but there is considerable variation in the leakage rates. A valve job would no doubt improve performance and economy.

CHEVROLET V-8 (1957)—15,800 MILES

Cylinders	1	8	4	3	6	5	7	2
Gauge Test Figs.	160	165	160	160	165	160	155	160
Cyl. Leak Tester Figs. (in %)	14	20	14	10	18	18	12	10

Engine in very good shape, with small variation in both compression pressures and leakage.

CHEVROLET SIX (1953)—50,001 MILES

Cylinders	1	5	3	6	2	4
Gauge Test Figs.	135	125	135	135	130	140
Cyl. Leak Tester Figs. (in %)	26	65	25	15	16	20

A striking example of where operator would be badly fooled by compression tester. Note that although No. 5 is 15 p.s.i. below the highest compression, leakage is 65%. This would definitely indicate a valve job, though compression test did not show it.

PONTIAC EIGHT (1950)—62,201 MILES

Cylinders	1	6	2	5	8	3	7	4
Gauge Test Figs.	110	120	120	120	110	120	125	120
Cyl. Leak Tester Figs. (in %)	24	32	28	18	26	18	16	30

On this engine No. 6 has twice the leakage rate of No. 7, with only 5 p.s.i. less. On the whole this engine would be considered to be in good condition as far as cylinders are concerned.

Servicing suspension systems

Wheel balancing, front-end alignment and front-end overhaul, make up a major area of profitable work. But to cash in properly . . . with benefit to both shop and customer . . . takes know-how, craftsmanship and proper equipment. Here are the basics for doing the job right, and very likely, far more often.

Part I—Evolution of Suspension

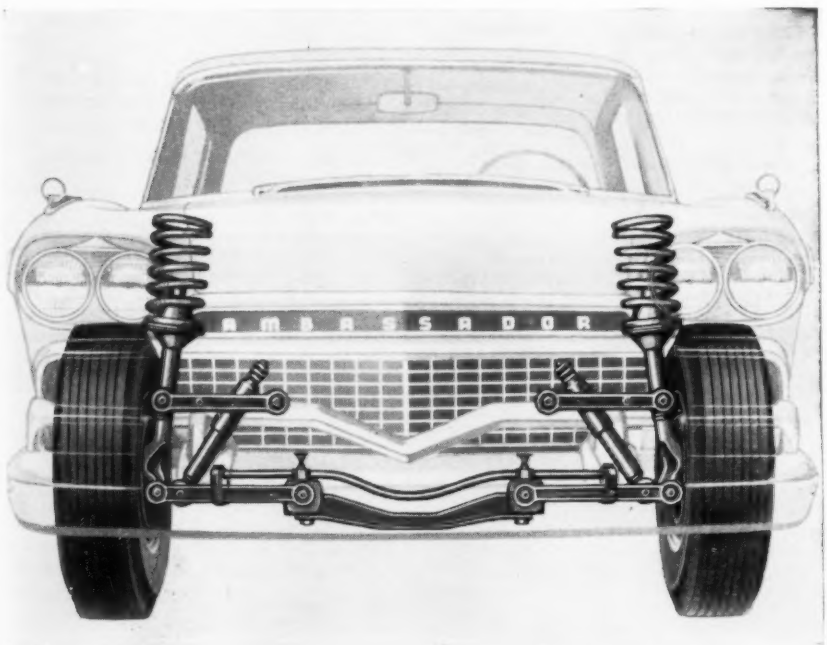
• THE TERM "SUSPENSION" can mean many things to many people. To the working automotive mechanic, it is generally interpreted as a method or manner of connecting front wheels to a vehicle's frame. In this discussion, and in future articles of this series, we'll use the term as it is applied in the general repair shop.

Early in the days of automotive design, many of the horse-drawn wagon principles existed for a number of years. This was natural because the first cars were little more than "horseless carriages," as they were affectionately known. However, some wagon ideas just wouldn't work on automobiles.

In the area of front wheel suspension, wagons were steered by pulling the reins either to the left or the right. This set the horse going in the desired direction. The wagon followed because the shaft connecting the wagon to the horse pivoted the entire axle and wheel assembly on a king pin which was located in the center of the wagon.

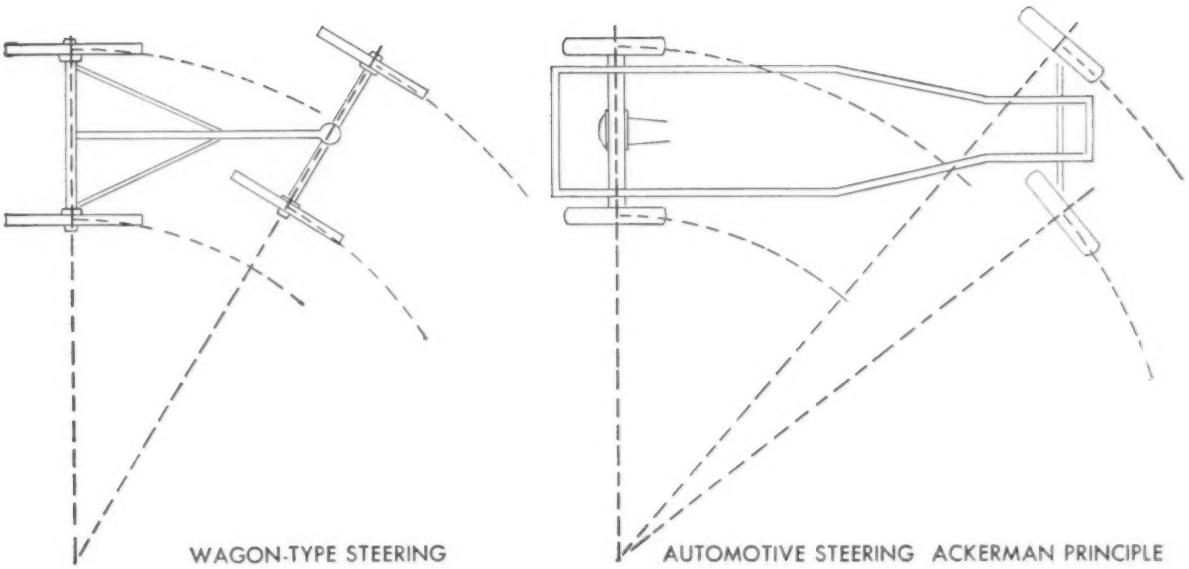
In automobiles, this method of steering wouldn't work so good. For one thing, the front axle would have to be extremely heavy and rigid to carry the weight. For another, steering would be difficult because of the size of the assembly to be moved by means of the steering gear. A third reason would be the excessive height of the body necessary to permit both front wheels to pass under the body.

The early means of correcting these conditions was to securely fix the front axle in one position. Then, to provide steering facilities, the front wheels were pivoted at the ends of the axle. This design is called the *Ackerman principle*, after the name of its discoverer.



Independent linked parallelogram is the technical name given to this type of front wheel suspension. A unique feature is the coil springs, located between upper seats of the steering knuckle pins and seats in the wheel housing panels. Notice short and long control arm arrangement; canted mounting of shock absorbers.

By HERB CARRIER
Detroit Editor



WAGON-TYPE STEERING

AUTOMOTIVE STEERING ACKERMAN PRINCIPLE

In horse-drawn wagons, front wheels are square with the axle, and wheels and axles pivot together as an assembly. In automotive vehicles, the front axle remains stationary, but the wheels are free to pivot. This basic of automotive design is known as the Ackerman principle; and it applies even when the axle is eliminated, as with independent front wheel suspension.

AXLE TYPES

Three variations of adaptions of the Ackerman principle became the most popular. These variations have to do with the manner by which the pivot points at the axle ends are arranged. Names applied to these variations are: Elliott, Reverse-Elliott, and Lemoine.

Elliott: An Elliott-type front axle is one in which the axle ends yoke over the steering-knuckle.

Reverse-Elliott: This type is the exact opposite of the Elliott-type the steering-knuckle ends yoke over the end of the axle.

Lemoine: This is the name given to a type of axle which consists of an "L" shaped steering-knuckle and spindle mounted in the end of the axle beam.

In any of these three common types of front axles, it is important to have the pivot points as near to the hubs of the wheels as possible. The closer they are, the less will be the amount of leverage to be overcome, and the easier it will be to steer. Also, the parts involved will be subject to much more favorable strain and stress characteristics, and, consequently, will be less subject to breakage.

Steering-knuckles and spindles were usually built in one piece. A king pin connected the assembly to the axle. Bronze bushings provided the bearing surfaces for the steel king pin. A tapered pin, with a nut and lockwasher, locked the king pin in position so that only the steering-knuckle and the bushings would be free to pivot. A front end overhaul on this solid axle suspension involved little more than installing new king pin bushings, king pins, and replacing any worn out tie rod or drag link ends. Plus, of course, reaming out the new bushings, and a generous amount of serious and furious cussing while pounding out the old king pins which more often than not were frozen in the bushings.

WHEEL WOBBLE

With the old solid tires and before the advent of front wheel brakes, little difficulty was experienced with well maintained fixed-axle front wheel suspension. However, when balloon tires and four wheel brakes came into use, front end troubles developed fast. One of the most annoying was the "front wheel shimmy," or "wheel wobble" brought on by the added weight of the tires and brakes, and the gyroscopic effect of the front wheels when striking road obstructions.

Briefly, gyroscopic action is the tendency of a wheel when turning in one plane to resist movement out of that plane. The rotating speed of the wheel determines the amount of gyroscopic action. For example, when pushing a wheel slowly, considerable attention is required to keep the wheel going in a straight line. However, if the wheel is pushed at a much faster clip, it is no effort at all to keep it going in one direction. This is but one example of gyroscopic action.

With this principle in mind, picture what happens when a rotating wheel is subject to road shock. Upon the initial impact the wheel might be thrown to the right. After passing over the obstruction, gyroscopic action forces the wheel to the left. Acting both on the steering gear and the spring, this right to left motion is apt to keep up indefinitely unless the speed of the vehicle is altered to upset the rhythm. A sudden snap of the steering wheel can also settle the wheel back to a steady rotating motion.

Excessive wheel wobble was overcome to a marked degree by improved shackling of the front spring. By having a movable shackle at the front end of the spring and a fixed mounting at the rear end of the spring, the spring will impart a motion which prevents, or tends to prevent, the wheel from undergoing excessive wobble.

AXLE TRAMP

Another undesirable action inherent in solid axle suspension systems is the tendency of the axle to "tramp." This action is unlike wheel wobble in that axle tramp involves the complete axle assembly, not just the wheels. It's possible, however, for both wheel wobble and axle tramp to occur at the same time.

Axle tramp is the alternate up-and-down bounce of the front wheels. When one front wheel hits a hole in the road, it drops down, then quickly rebounds upward. The opposite front wheel will go downward in direct proportion, then it too will rebound causing the first wheel to

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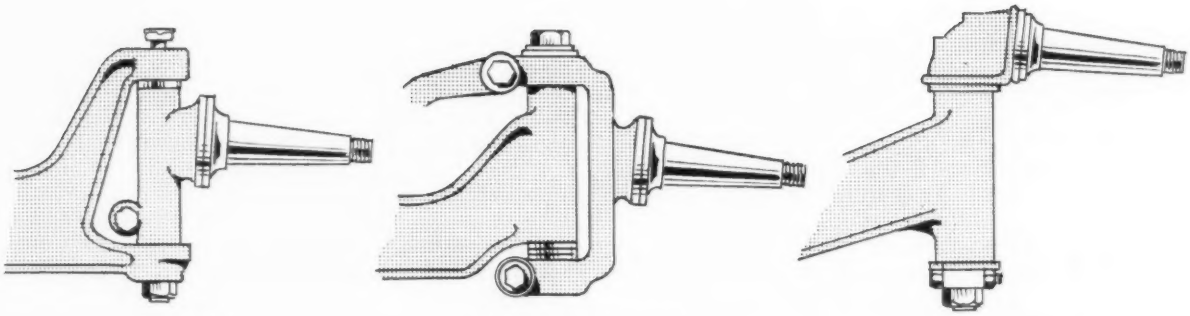


ELLIOTT REVERSE ELLIOTT LEMOINE

The three common types of solid axle front suspension: Elliott, Reverse Elliott, Lemoine. In the Elliot design, axle ends yoke over the steering knuckle. In Reverse Elliott, steering knuckle ends yoke over the axle. The Lemoine design involves an "L" shaped spindle assembly, which is mounted in the axle.

Suspension Systems . . . CONTINUED

go downward. This up and down cycle can go on until it peters out on a smooth surface. Occasionally, some cars would tramp so much that they couldn't get above a critical tramping speed.

Again, design improvements and hydraulic shock absorbers helped remedy the situation, but is always present in solid axle installations in various degrees.

INDEPENDENT SUSPENSION

The big break in overcoming the undesirable features of solid axle suspension was the introduction of independent front wheel suspension. This design permitted the front wheels to move up and down independently of each other in such a manner as to maintain the wheel planes closely parallel to the center plane of the vehicle.

Many advantages came with this type of suspension. To name a few, wheel shimmy was brought under control, softer springing was possible, unsprung weight was reduced, and directional stability was greatly improved.

Various designs of independent front wheel suspension were developed. In Europe, where this suspension was said to be first used, numerous and novel systems were introduced. Even today the foreign imports have dozens of unique independent suspension systems. In this country, too, several basic designs were exploited. Four definite types are the swinging-arm type used on some Chevrolet and Pontiac cars, parallel short and long arm suspension used with a coil spring, traverse spring suspension as found in the Studebaker Planar unit, and the vertical-moving steering-knuckle system used on small Nash products.

Out of all this, the short and long arm system seems to have lasted the longest and has become the most popular in the manufacturing of today's cars.

S.L.A. CONSTRUCTION

General construction of a short and long are independent front wheel suspension system consists of an upper and a lower "A" frames, or control arms. The upper represents the short arm, and the lower the long arm. The long arm is mounted below the car's frame and the upper above the frame.

The outer ends of the arms are connected to a steering-knuckle support which is, in turn, connected to the steering-knuckle and spindle assembly.

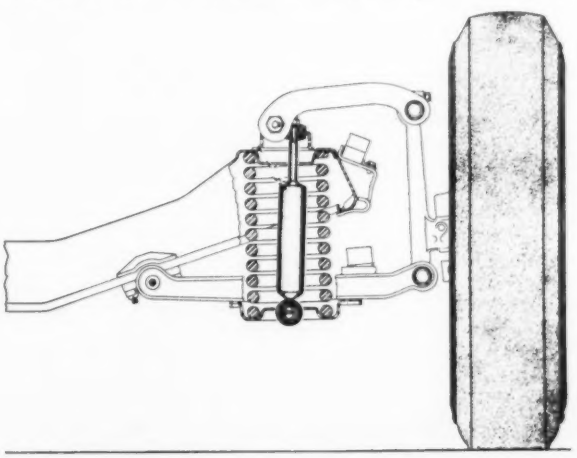
A coil spring is mounted between the two arms, and usually a bayonet-type shock absorber passes directly through the coils. Rubber bumpers are mounted on the frame cross members, or on the "A" frames to prevent a metal-to-metal contact if and when the spring bottoms.

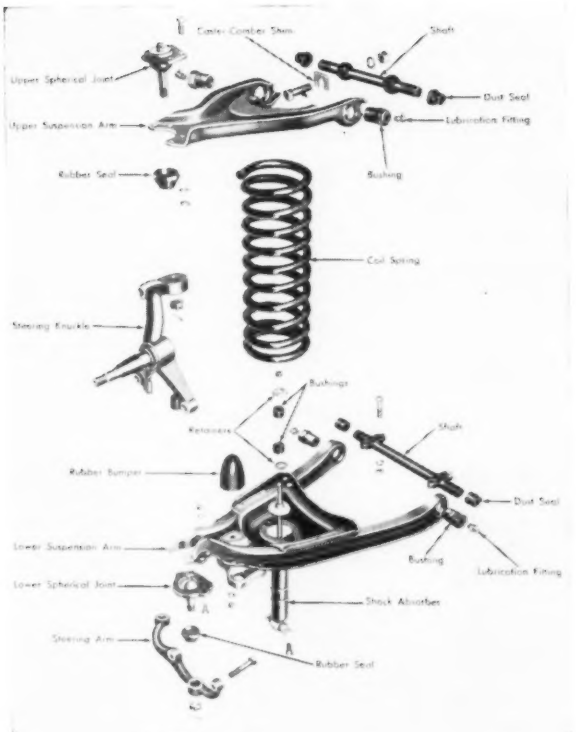
In operation, an independent front wheel suspension assembly works to provide much improved handling, riding, and over-all performance than solid axle suspension systems. When an independently suspended front wheel hits an obstruction in the road, it's forced upward carrying both the lower and the upper arms with it. If the arms were of equal length, the wheel would be thrown outwards at the top as the arms pivoted on the cross member mountings. This is the reason why the upper arm is shorter than the lower arm. With this short and long set-up, the wheel rises vertically instead of tipping outward at the top and inward at the bottom.

Having the wheel rise vertically greatly reduces tire scuff and scrubbing by avoiding wheel side slip. In actual operation, the wheels do not rise perfectly vertical, but are permitted to tilt slightly inward at the top. This is to maintain a constant distance between the bottoms of the two front tires. Holding this dimension constant greatly increases the car's tracking ability, which, again, adds to longer tire life and better vehicle performance.

With independent suspension, each front wheel is free to negotiate road conditions without influencing the operation of the other front wheel. In the case of a severe chuck hole which could cause axle tramp in solid axle suspension, the independently suspended wheel would hit the hole, bounce, and return to the road without trans-

Standard king pin type of independent front wheel suspension includes a short upper and a long lower control arm. A coil spring is mounted between lower arm and the frame cross member; and a shock absorber passes directly through the coil spring.





Ball joint suspension systems eliminate the need for king pins, but retain the basic conception of the S.L.A. (short and long arm) construction. Ball joint systems usually employ shims for adjustment of caster and camber. The shims replace the threaded adjusting pins that are found in king pin installations.

mitting an appreciable affect on the opposite front wheel. In addition, sway bars, or stabilizers are generally included with all independent front suspension systems.

The stabilizer bar is mounted across the frame and connected, in most instances, to the lower control arms. The bar itself is connected to the frame through a rubber bearing. Links at the bar ends connect the bar to the control arm. This results in an actual mechanical linkage between the two lower control arms. In operation, any action of one control arm is transferred to the other control arm. Stabilizing effect is obtained when rounding corners because when one spring tends to compress, the stabilizer bar comes into action to hold both front springs in a near equal state of compression. This helps keep the body on an even keel.

ADJUSTMENTS

In the early solid axle suspension system, front end adjustments were held to a minimum. Caster, camber, and king pin inclination were built into the design and could not be changed without bending the axle or the steering arms. Practically the only adjustment which was provided for mechanically was toe-in.

Lack of adjustments reduced the maintenance to a bare minimum. Barring accidental damage, solid axle suspension systems seldom required anything more than a toe-in adjustment. Excessive spring sag, or badly worn front end components could throw the system out of alignment, but the fault was not one of adjustment, but of replacement.

Independent front wheel suspension brought in many important advantages, but it also increased the cost of maintenance, adjustment, and overhaul. For one thing, there are more moving parts on an independent suspension system which utilizes king pins. Caster and camber adjustments are provided through use of threaded pins or sleeves. A comparatively minor bump against a cement curb is enough to throw such a system out of alignment. Spring sag or grossly unequal passenger or luggage distribution can also cause misalignment. The increased number of lubrication fittings represented more wear points over the solid axle suspension. Car buyers paid a maintenance premium for independent front wheel suspension, but with everything considered the advantages it made possible were well worth it.

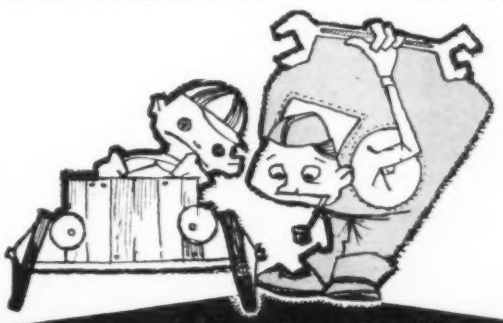
HERE TO STAY

It's evident that separately suspending the front wheels is the type of front end which is here to stay for a good long while. There have been major improvements in the design—ball joints for one thing—that have served to simplify the construction and, hence, the cost of maintenance. Also it has been discovered that different angles of control arm mountings improve steering and tend to eliminate, or greatly reduce, the annoying "nose diving" feature usually associated with softly sprung front ends.

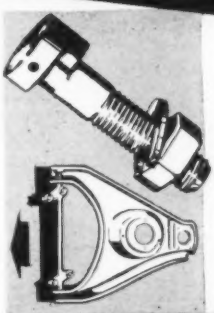
A working mechanic with a solid understanding of suspension evolution will appreciate the tremendous advances made in front end design, and will be in a better position to render more intelligent service on the cars which enter his shop for front end work.

In future articles of this series we discuss the various factors of ball joint systems, wheel balancing, torsion bar suspension, front end alignment, front wheel service, and steering service.

Say You Saw It In Automotive Service Digest



Camber Adjusting Problem?
EASY Solution: Houser No. 720



As front suspension parts wear and the front coil springs "set" negative camber results. On 1955-56-57 Chevrolets, positive camber is increased as shims are removed. When all shims are removed, additional adjustment is impossible.

HOUSER'S NO. 720 CAMBER ADJUSTING BOLT permits moving the lower control arm just 1/8" toward the center of the car. This increases positive camber one full degree and allows regular shims to once again be used for final adjustment.

Installation of Houser's No. 720 is easy — no disassembly, no bending, no new parts required. Takes less than an hour to drill and install bolts on both sides.

Fits 1955-57 Chevrolet; 1957-58 Buick
Positive • Permanent • Profitable
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How To Check Inflation . . . On Captive-Air Safety Tires

The Captive-Air Safety Tire, with its two independent air chambers, is designed so that should a blow-out or puncture occur on the outer chamber, the inner chamber can safely carry the vehicle at a reasonable speed for 100 miles or more.

The two air chambers in each tire are completely independent of each other, and each section must be inflated to its proper pressure separately, or the effect of the double air chamber is lost. If the inner chamber is not properly inflated, it cannot support the car, and the result of a loss of air pressure in the outer chamber will be the same as a tire without the safety feature.

To assure that both chambers in the tire are inflated, it is recommended that the following procedure be used when checking tire pressure on cars equipped with these tires:

1. Insert the inflation needle valve (furnished with tire) into the tire sidewall valve.

2. Loosen the needle valve core (core cannot be completely removed) and allow the outer chamber to deflate completely.

3. Inflate the inner chamber through wheel rim valve to recommended pressure.

4. Tighten needle valve core and inflate outer chamber through needle valve to recommended pressure.

Important: *Never* try to equalize inner and outer air chamber pressures by letting air out of the inner chamber. The inner chamber pressure should always be 2 to 4 pounds higher than the outer chamber.

Air pressure check on the wheel rim valve is *not* a true indication that the inner chamber is inflated unless the outer chamber is deflated as described above.

PROFIT FROM MOTORIST'S NO. 1 ENEMY

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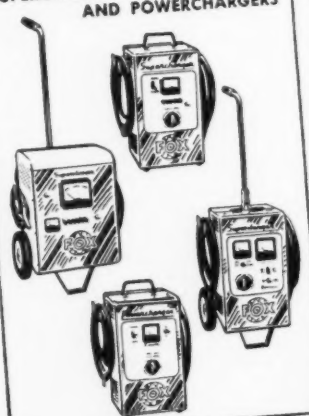

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Write today for FREE "Get Your Battery Checked" SIGN and Profitable Hints on Battery Servicing. Fox Products Co., 4704 N. 18th St., Phila. 41, Pa.

FOX BATTERY SERVICING EQUIPMENT

Vacation Motoring Shows Steady Rise

Travel experts attribute a steady rise in vacation motoring mileage to longer paid vacations, higher annual incomes, more retirement programs, and, probably most significant, a tremendous increase in private car ownership.

There are 56 million cars on the road today, compared with about 30 million 10 years ago, points out the American Finance Conference, national association of independent sales finance companies. In 1957, motorists drove a record total of 11.5 billion miles on vacation trips.

Gap With Care

A strong right arm can deal a death blow to spark plugs when setting the gaps. A warning issued by the engineers of the Champion Spark Plug Co. emphasizes that mechanics can ruin a spark plug by exerting excessive pressure on the center electrode. You may damage the interior pressure seal, resulting in severe leakage, burning and shortened spark plug life. Instead, use a good spark plug tool and exert pressure *only on the ground electrode* when setting gaps.

GIVE

THE UNITED WAY

Universal joint service

Before a propeller shaft is installed in a motor vehicle, the complete assembly should be carefully balanced to minimize noise and vibration. All parts also must be in good condition before balancing is attempted.

By BEN IKERT
Editor

• A PROPELLER SHAFT consists essentially of two universal joints connected by a steel tube with the inclusion of a sliding spline at one end. As stated in the first article of this series on universal joints, (ASD, November, 1957) the function of the propeller shaft is to transmit rotary motion of the engine to the rear axle during which propeller shaft alignment and length are constantly changing.

The alignment and length between the transmission output shaft and rear axle drive pinion shaft vary with load, spring action due to road irregularities, flexing engine mounts, axle movement due to torque and brake reactions, mounting tolerances and deflections.

Propeller shafts have a critical whirling speed and during the design of a motor vehicle chassis, careful consideration is given to make sure that maximum operating speed is below the critical whirling speed. The maximum safe operating speed is determined by the length and tube diameter, and since the speed is inversely proportional to the length squared, a small increase in tube length has considerable effect on safe operating speed.

In a motor vehicle the propeller shaft, when operating at high speed, will whirl somewhat in the same way as a piece of rope when swung around by two persons. If the two persons stop the whirling, their hands will still be carried around in a circle. This is the case, too, with the propeller shaft supports. The shaft supports include the universal joints which, in turn, are fitted to short shafts overhanging their bearings. Through the effect of centrifugal force on the propeller shaft, the short shafts will flex in the same plane as the propeller shaft, which virtually increases the distance between the propeller shaft supports. Obviously, the effect depends upon the overhang of the connected shafts and the relative stiffness of the assembly.

VIBRATION

Vibration is considered the most common drive line disturbance. Either transverse vibration or torsional vibration can cause this disturbance. Noise and vibration from unbalance can be troublesome.

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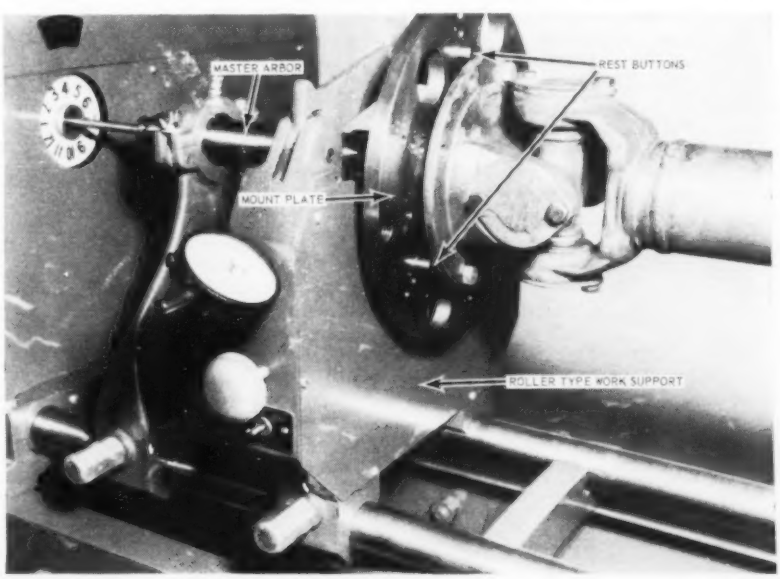


Close-up showing a flange type drive shaft mounted on one master mount plate of the balancing machine.

U-Joints . . . CONTINUED

Transverse vibration is the result of unbalance acting on the supporting shafts as the propeller shaft rotates. Any part having a heavy side (out-of-balance), when rotated, creates unbalanced centrifugal force which increases as the square of the speed.

The unbalanced centrifugal force rotates with the out-of-balance part and the fixed or stationary member supporting the rotating shaft has the force applied in opposite directions (described in the August, 1958 issue of AUTOMOTIVE SERVICE DIGEST under *Single and two-plane balancing.* The equipment for balancing in both instances is essentially the same; difference in procedure is in the set-up required.

Illustrations in this article show the set-up for a flange type propeller shaft, the flanges of which are attached to master mount plates, the holes in which make it possible to accommodate practically all drive shaft flanges. For balancing end yoke type drive shafts, two special chucks are used; one being bolted to the left flange end arbor, the other to the right flange arbor.

To insure a satisfactory balancing job on a propeller shaft, all parts, including universal joints and mating transmission and differential companions flanges (or yokes), should be on hand.

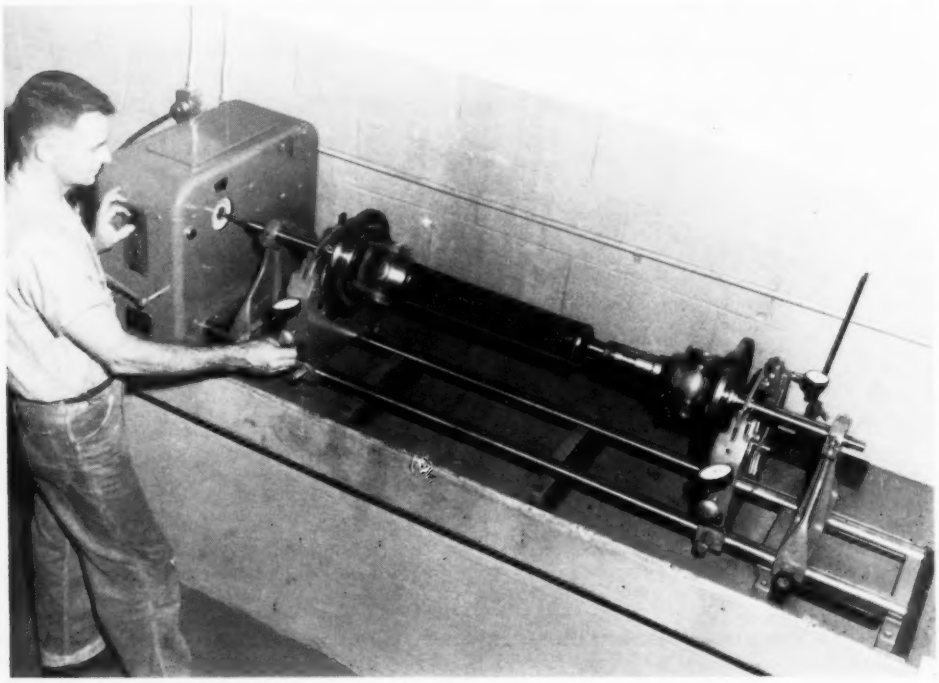
The availability of these parts is not only necessary for balancing in complete assembly, but more important in that they enable the mechanic to check the complete shaft and components for discrepancies. If these exist, they should be corrected by reworking or with new parts before balancing.

Examples of questionable items are worn splines, crosses, bearings, etc. Tight bearings and crosses causing "sticky" universal joints means trouble in balancing attempts. To insure correct balancing, all parts of the propeller shaft assembly must be in good mechanical condition. **This is very important.**

With the drive shaft properly mounted in the machine and locating from the pilot diameter or O.D. of the flange, the flanges are bolted to the mount plates and the shaft two-plane balanced. It is balanced like a crankshaft as told in our August 1958 issue.

CONCENTRICITY CHECK

With the drive shaft set up in the balancing machine and the flexing head beam lock pins in position, the drive shaft is rotated under power at low speed. A dial indicator gauge is placed on the spline shaft (at opening between the tube and collar on the slip joint) and the total indicator run-out should be within .005". If this reading is greater than .005" the drive shaft must be disassembled and the spline shaft and tube straightened, as described in previous articles of this series.



Operator bringing drive shaft up to balancing speed. He is about to close selector switch (right hand) to pick up angular position of unbalance on left hand work support.

each half turn, or one complete reversal every revolution.

Unbalance is measured in inch-ounces. For example, 1-oz. of weight on a 2" radius from the center of a balanced shaft causes an unbalance of 2 inch ounces. Or, a 2-oz. weight on a 1" radius also causes an unbalance of 2 inch ounces. Similarly, a weight of 1 oz. on a 1" radius causes a 1-inch-ounce unbalance. A 1 inch-ounce out-of-balance in itself is a small amount, but revved up to 1,000 r.p.m. it exerts a force of 1 lb. 13 oz., and at 3,000 r.p.m., 16 lbs. 7 oz. Thus, at 3,000 r.p.m. a 16 lb. 7 oz. load, applied alternately in opposite directions would have to be absorbed by the supporting members 3,000 times a minute.

BALANCING PROPELLER SHAFT

The balancing of propeller shafts, both end yoke type and flange type, follows the same general procedure as balancing an engine crankshaft

CORRECTION OF DRIVE SHAFTS

Propeller shafts can be balanced with temporary connection weights (body calk, etc.) at least until the mechanic becomes familiar with the balancing machine. Generally the temporary weights are located on the extreme ends of the tube, adjacent the weld. When final drive shaft weight correction is made on one end of the shaft the temporary weight on the opposite end should not be re-

Operator checking the spline shaft for total indicator run-out, which should be within .005".

moved or disturbed until the first final correction has been made.

The actual final correction and type of correction is generally governed by the amount of unbalance in the drive shaft. If the amount of correction required does not exceed 2 to 3 oz. it can be made on the tube adjacent the weld. In cases such as this it is suggested the area around the temporary weight be marked with chalk, the weight removed, weighed and matched with a round, square or rectangular shaped piece of steel, shaped to the radius of the tube. When applying the weight to the tube it should be shaped *around* the circumference of the tube rather than being placed on the tube lengthwise. The steel weight is tack welded on each end a sufficient amount to hold it securely in place.

KEEP HEAT TO MINIMUM

Test again in machine for balance. If more weight is required the mechanic lays a bead along side of the steel weight on top of the original tube weld. Always, when welding, the mechanic should hold the amount of heat applied to the tube at an absolute minimum to prevent tube distortion and bending. If too much weight has been added it is suggested the steel weight be drilled with a portable drill. When applying the temporary weight, if a reasonable amount of precaution is taken to hold the height to an equal thickness over the tube area covered, it will be found that the final correction weight when applied centrally within the chalked area will come fairly close, if not "on the head," to equaling the temporary weight.

For drive shafts where the amount of unbalance is in excess of 3 oz. the amount is too great to put on the tube. In cases such as this it is suggested the major amount of unbalance be taken out by welding a steel weight to the yoke. With the major unbalance removed the final 1 or 2 oz. weight can be welded in place on the tube. When welding in the machine always ground the welder to the drive shaft—not to the balancing machine.

Since many shops have arc-welding equipment on hand, such equipment does a good job in applying correction weights to propeller shafts. But a word of caution is injected here: The mechanic should hold the correction weights as closely as possible to their weld. Also, if more than one weight is required the drive shaft tube should be cooled with a wet rag before adding the second weight. Tube distortion from heat causes considerable eccentricity which, in turn, will require more correction weight to obtain balance. The closer the tube is held for concentricity the less the amount of correction weight required.

ACCURATE CENTERING ESSENTIAL

The final degree of balance obtained in the vehicle is determined by the centering, provided by the supporting shafts. The concentricity of the supporting shaft, brake drum or disc, and mounting flange or yoke plus the face runout of shaft shoulders, bearings, flange, brake drum or disc, spline fit and shaft nut tightness—all affect the concentricity of the drive line installation. Accurate centering is as important as balancing for satisfactory high speed operation.

(Continued on following page)

Mechanic about to tack weld a correction slug (weight) to the drive shaft. Shaft should be cooled with a wet rag before second weight is applied.

U-Joints . . . CONTINUED

The energy produced by out-of-balancing tends to bend the supporting members back and forth at the speed of rotation. As the supporting members have a natural frequency of vibration similar to a swinging pendulum, a violent vibration may exist at certain periods when the speed of rotation and natural frequency of the supports coincide. This condition can be compared to a playground swing where a small push synchronized with the back and forth motion makes the swing go higher and higher. If the force is applied to the swing with a different timing (not synchronized) the back and forth motion is immediately reduced and the swing comes to rest.

On the same basis, the supports are designed to have a natural frequency out of the operating range of the rotating parts but even then the force is transmitted to cross members, body panels, or similar parts which also have their natural frequency of vibration.

VIBRATION CHARACTERISTICS

Vibration caused by drive line out-of-balance usually has the following characteristics: Transverse vibrations emit sound waves that you hear and transmit mechanical shaking that you can feel. The force from out-of-balance increases with speed; therefore, the vibration tends to be more severe at high speed. Normally, the vibration caused by out-of-balance is not affected by changes in torque load, part to full throttle operation. The drive line speed is determined by vehicle speed and the vibration is demonstrated best by road testing vehicle to top speed, disengaging engine, and checking vibration while coasting, with engine noises eliminated.

Torsional vibration, although similar to transverse vibration, is an entirely different motion. The transverse vibration is a bending movement whereas torsional vibration is a twisting motion, as found in the balance wheel of a clock. Just as the balance wheel has a uniform speed of oscillation, a drive line installation also has a natural torsional frequency and a small force applied at the right time will increase the amount of oscillation and result in a vibration period.

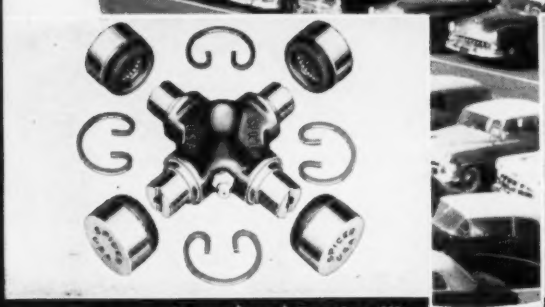
ACT AS FLYWHEELS

The time of oscillation or natural torsional frequency is determined by the torsional stiffness of the shafts and the size and location of the flywheels. In addition to the engine flywheel, all rotating parts have weight (such as gears and brake drums) and act as flywheels.

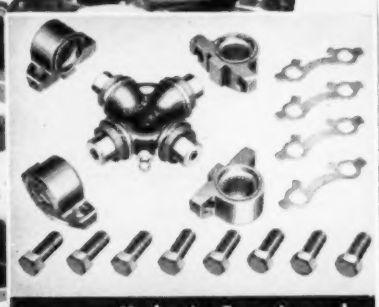
The energy to produce torsional vibration can occur from the power impulses of the engine or from improper universal joint angles. Torsional vibration is difficult to identify in road testing, but certain characteristics do exist. Generally the vibration causes a more noticeable sound disturbance and only occasionally transmits mechanical shaking. Torsional vibrations can exist at one or more periods any place in the operating range and tend to be most severe at lower speeds. Changes in torque load, part to full throttle, usually affect the vibration.

Millions of Profit Opportunities in Universal Joint Kit Replacement Sales

Spicer Journal and Bearing Kits Bearing Cap Type



Spicer Journal and Bearing Kit Snap Ring Type



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Let Spicer fill *all* your journal and bearing kit service requirements. Spicer is world famous for construction, quality, performance and acceptance.

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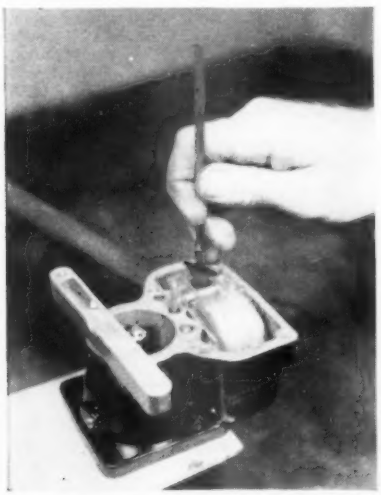
"You'll do alright as shop foreman, Eddie. Already the boys are beginning to hate your guts!"

Setting Float Levels

● WHEN MEASURING the float level in a carburetor, it should be obvious that the carburetor itself should



be level. Note how a small spirit level at the left of the carburetor is being used by this mechanic to be sure that the carburetor housing is absolutely level while the float level is checked.

Increased Valve Clearance Recommended by Plymouth

Plymouth reports improved torque and idle characteristics are possible on their 277, 301 and 318 cu. in. 1957 engines and the 318 cu. in. 1958 engine by increasing the intake valve clearance from .008″ to .010″ at hot idle. The change is also reported to reduce valve face and seat wear.

Exhaust valve clearance recommendations still remain .018″ at hot idle.

Mercury Toe-In Increased

Road tests of 1958 Mercurys indicate that they and the 1957 models will have longer tire life if the toe-in is increased from the present 1/16″ minimum and 3/16″ maximum to 3/16″ minimum and 5/16″ maximum. Such a change was recently made on the production line.

Dodge Master Cylinders Have Built-In Pedal Stop

According to a recent Dodge Technical Service Bulletin, Dodge cars built since March 9, 1958 with conventional brakes now have a pedal stop built into the brake master cylinder which eliminates the necessity of a free play adjustment on the master cylinder push rod.

The stop on the brake pedal, and the brake pedal return spring are also eliminated by this change, which results in a somewhat slower brake pedal return when brake is released. This is not detrimental, but if a binding action is found at brake pedal, the cause of binding should be eliminated.

Since the master cylinder piston determines the position of the brake pedal when the brakes are released, a free play at the pedal is no longer needed. However, if pedal is pulled back by hand, some play may be noted, due to clearance allowed at the push rod eye for self alignment of the push rod. *Caution: Pulling on the brake pedal, in a direction away from the master cylinder, with a force of 50 lb. or more, will result in deflection of the piston stop. Since this would result in excess pedal travel before any braking effort would be realized, this action should definitely be discouraged.*

During disassembly, the master cylinder push rod cannot be removed from the piston; therefore, these parts, along with the piston stop and boot retainers, are removed from the cylinder as an assembly and are also serviced as an assembly.

The new and old type master cylinders are *not* interchangeable, as the old type necessitates installing a pedal stop and a pedal return spring, as well as the adjustable push rod and nut.

It's the Tool Set of the Year!

RIMAC **Hexset** NO. 777

TAPS and DIES

that cover the Autofront!

- **ALL DIES HEX — for use with standard wrenches. Assures positive grip.**
- **17 TAPS AND 17 DIES — to handle *all* the jobs.**
- **3 TAP WRENCHES — for efficiency in any size.**
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- **11 FRACTIONAL SIZES — ¼ to ½ NF and NC, ⅛″ Pipe.**
- **6 MACHINE SCREW SIZES — needed in the repair shop.**
- **SMART MAROON CHEST — strong, light and compact. Molded of durable polyethylene plastic.**

The RIMAC 777, new champion in the Tap and Die field, is a combination of the mechanic's favorite Hexsets No. 77 and No. 73 . . . It features all popular tools of both sets plus others that are unique to the RIMAC line and the trade. The RIMAC 777 was designed by mechanics for the garage mechanic.

Ask your jobber or write for literature.

RINCK-McILWAINE, INC.
16 HUDSON STREET • NEW YORK, N. Y.

Instrument Corner . . .

(Continued from page 8)

"Friday it was the same thing over again. My neighbor gave me a push once more and told me to go to the shop where he gets his work done. They said the battery was weak, so they sold me a new battery, and I thought that now my troubles would surely be over. But here it is Saturday and the engine won't start again. Will you give me a push—and tell me where I can go to get this blankety blank machine really fixed?"

The Instrument Man told him to go to Ray's Garage, which was not too far away, and to tell Ray that the Instrument Man had sent him.

Monday morning the neighbor again hailed the Instrument Man, and this time he had a smile on his face. "You know, Jim, that guy Ray is a whiz," he told him. "When I came in and told him you sent me, he just smiled, got out some instruments, made a few quick tests, and then told me that all I needed was a new ground cable. It didn't take him over ten minutes, and this morning the engine started on the first compression. What burns me up is that Ray only charged me $3.50 for really fixing my automobile while those other birds charged me over $40.00 and didn't fix it!"

"Ray certainly gets all my service work from now on, and I will send my friends to him also. It sure is good to know of a shop where they know their stuff."

So the Instrument Man had something nice to tell Ray the next time he saw him.

Wrong Number

While the Instrument Man was calling on one of the shops in his territory, a man came in with a 1955 Ford V-8, with the complaint that the generator was not working. The man on the job put an ammeter in the charging circuit and ran the engine. The engine was speeded up, and sure enough, there was no charging current. Then he put one end of a jumper on the armature terminal and the other on the generator field terminal. Remember, on the Ford cars they use the so-called heavy duty circuit, or as Delco-Remy calls it, the "B" circuit, in which the generator field circuit is grounded in the generator instead of at the regulator, so the connections made were correct. Again the engine was speeded up, and no charging current was indicated. The generator was correctly mounted and was the right generator for the car, and the drive belt was in good shape.

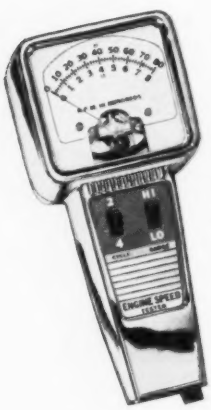
About this time the owner explained that this generator was not the original one; in fact he had had two generators installed other than the original and three regulators, one in each of the three shops he has been in, in the last two days.

The Instrument Man watched with considerable interest as the service man removed the generator, tested it,

NOW — 2 PORTABLE TACHOMETERS ...to service any type of engine!

KAL-TACH

The original portable automotive tachometer. Simplified controls and connections . . . no polarity to observe . . . low load characteristics assure that it can't cause motor misses while testing. The tachometer built with automatic transmissions in mind.



NEW MODEL M-201 H. T. TACHOMETER

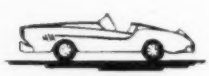
If you can reach a spark plug, you can use this new Tachometer. All the simplified operating features of the famous KAL-TACH in a unit that connects to any spark plug for reading RPM on all engines . . . 1 to 12 cylinders, battery or magneto ignition, 2 or 4 cycle. Dual range dial reads 0-800 and 0-8000 RPM. No outside power source required.

Again, KAL-EQUIP "scoops" the market with a choice of tachometers . . . the KAL-TACH for normal automotive tune-up work, and the new Model M-201 with the right range, the right hookup and the right operating characteristics for testing all gasoline engines.

KAL-TUNEMASTER . . . complete set of portable tune-up tools in a handy carryall case. . . . Includes KAL-TACH plus dwell tester, ignition tester, regulator tester, and power timing light . . . all at a remarkably low price!

OUTBOARDS & INBOARDS

LAWN MOWERS



SPORTS CARS

TRACTORS

INDUSTRIAL GAS ENGINES

PASSENGER CARS & TRUCKS

AIRCRAFT

Get them from your Jobber!

KAL-EQUIP COMPANY
OTSEGO, MICHIGAN

"Everyone is quitting, Boss. We have an opening for you at our own repair shop down the street."

found nothing wrong, and replaced it. All the wires and connections looked OK, but the wires were dirty and in a loom. So with the wires removed from the generator and using the battery as source of current, the field circuit and ground circuit were tested, and guess what! The field wire from the generator had been attached to the ground terminal of the regulator and the ground terminal of the generator had been connected to the field terminal of the regulator. The field wire and the ground wire being the same size look alike, and it was easy to mix them up, resulting in an inoperative generator.

Properly connecting the wires was all that was required to get the generator working again. The service man, who was one of the proteges of the Instrument Man was doing very nicely, so he was not interrupted, and the I.M. was quite gratified to see the good results of his coaching. Needless to say the customer was happy to have his car trouble actually corrected, and at very moderate cost.

Spark Plug Boots Wear Out —Check Them Regularly

The spark plug shown here through the courtesy of the Champion Spark Plug Co. was one of several on an 8-

cylinder engine which started misfiring as a result of deteriorated rubber boots.

When spark plug boots are in good condition, they will provide added protection against flashover under extreme moisture conditions. However, once the covers have become oil soaked or cracked, they can cause real trouble. Notice how the grease on this boot had formed a carbonized path over the spark plug insulator, completely shorting out the plug. Either complete removal of the boot or replacement with a new one would have solved this difficulty.

When Timing '58 Buicks Check Distributor Model

Sometimes overlooked is the fact that two different distributors have been used in 1958 Buick production. As a result, basic timing varies as follows:

Standard trans. & early Dynaflow:
distributor 1110870 .. 4° BTDC

Later Dynaflow:
distributor 1110934 ..12° BTDC

With the 1110870 distributor, engine r.p.m. must be reduced to 400 while setting timing so that the advance mechanism isn't operating. This isn't required on the 1110934 unit.

Note also that the earlier '58 cars had timing indicators marked "O" and "5," with two additional line indicating 2½° increments. Later jobs are marked 0-5-12.

Who'll train the service specialists our automotive shops need—*soon?* The October Service Education feature will offer all the facts on another ranking program.

$10,000 SAVED BY PANELBLOC INSTALLATION IN AUTO SALES AND SERVICE AGENCY

When Paul McGlone Chevrolet, in suburban Detroit completed their new showroom-service center, they asked for bids on heating.

When the bids were opened, it was discovered that a battery of Panelbloc gas-fired heaters, installed complete, **would cost $10,000 less** than a conventional heating system. Mr. McGlone specified Panelbloc.

After two full season's use, Mr. McGlone is still realizing savings. His fuel bill is less than anticipated. His entire floor area is clear for display or repairs. Mechanics turn out jobs faster, and customers can examine his display in comfort—regardless of outdoor temperatures.

Write for information on this and other money-saving Panelbloc installations in garages and service stations.

Thermobloc Division
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Gentlemen: ( ) Please rush literature on Panelbloc
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Where "pull" really counts

There are two ways to handle body repair work—the costly, time-consuming, muscle-and-hand-tool way; or the profit-making way, using modern, time-and-labor-saving power equipment designed especially for this type of work.

● INTRODUCTION OF THE hydraulic body jack a few years back provided shopmen with a means of applying a powerful force to distorted body and frame parts, thus permitting the handling of straightening and aligning jobs that were previously extremely difficult or impossible.

However, today's low slung, unitized construction and "squeezed-in" body styles present many additional problems, which make it almost impossible for the body man to repair sheet metal and body damage economically without a "sky hook" to which to anchor his equipment.

And a "sky-hook" he was given, in the form of the "Pull-dozer"; especially designed to provide a powerful *pulling* force. Since in practically every type of sheet metal damage, metal is pushed in toward the center of the body, the logical way to correct the damage is to *pull* the deformed metal back into its original shape and position.

The hydraulic body jack has been extensively and successfully used for this purpose. However, where it can be applied, a problem is sometimes presented in finding a suitable spot for locating the stationary end of the jack. There is always just as much force applied to the stationary end of the jack as there is to the working end; and while we do want the working end to move metal by means of the force applied, we do *not* want the stationary end to move or distort any metal of the frame or body.

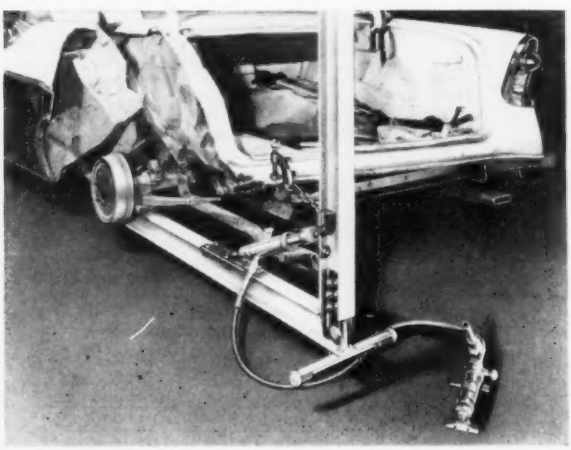
The Pull-dozer, by applying a pulling force with a chain instead of a pushing force with a jack, can get at many more places on the damaged body, and can perform many more corrective operations.

In use, the horizontal I-beam is located in the desired spot in line with the direction in which it is to pull, and the end opposite from the pivot point is anchored to the frame of the car. Then a chain is clamped or otherwise attached to the working or movable upright beam by a clamp which is adjustable to any position on the upright beam, and the other end of the chain attached to a clamp or fixture which is connected to the part to be pulled.

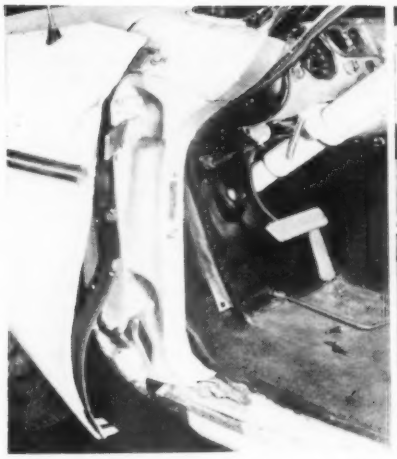
By working the pump which comes with the device, the hydraulic jack moves the working beam and pulls the chain which in turn pulls the deformed part. Care should be taken to have the horizontal beam and chain positioned so there will be a direct, in-line pull on the damaged part,

Extensive damage to rear quarter panel and trunk floor is both costly and difficult to repair. Here a "C" clamp attaches pulling chain of Pull-dozer to sheet metal of inner panel. This relieved the stress on the buckled up trunk floor, allowing panel to be cut away.

Next a pull from the same direction of the striking force brought trunk floor back toward its original position. With floor under tension, slight dinging and hammering restored it to original shape.

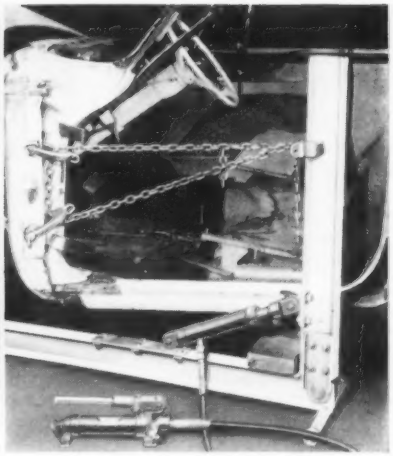


The inner panel and floor are now back into form and position, with the new quarter panel in place. This job was completed in much less time than would have been required by any other method.



On this car the rear of the left front fender and left front door post were pushed forward almost 7", with the consequent displacement of other parts.

With two "C" clamps attached to the cowl and fender sections, the tool's powerful action made it possible to pull them back at the same time . . .

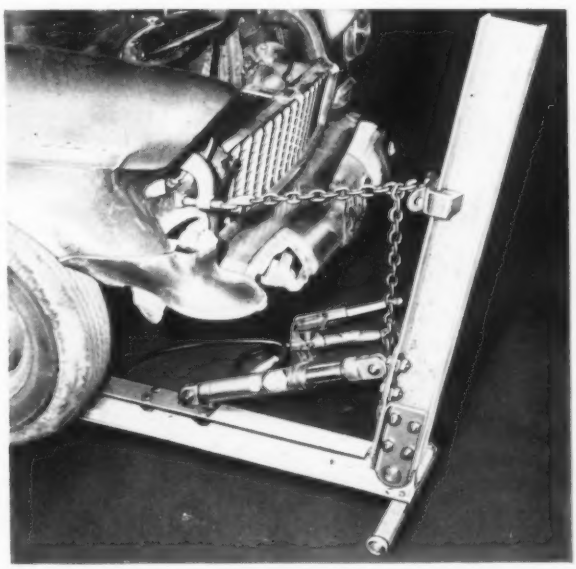


. . . after which the "C" clamps were attached to the pillar, where the smooth, steady pull of the equipment brought the pillar back into its proper position.

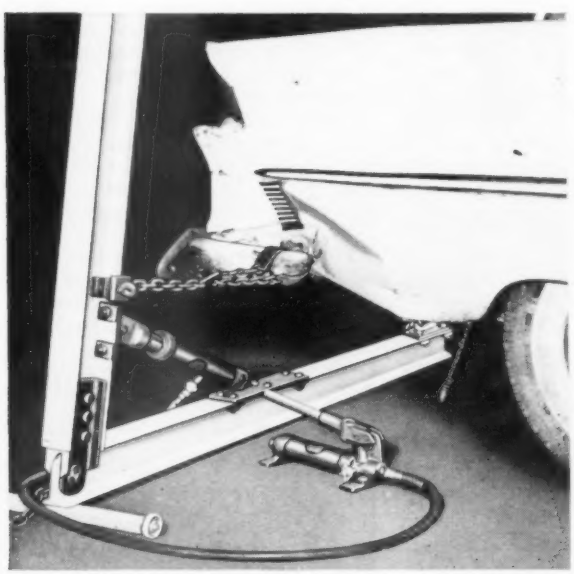
with no up, down, or side pull.

The accompanying illustrations show just a few "body-man's headaches" that can come up from time to time, and how, with the Pull-dozer, it is possible to pull damaged parts back into their approximate position. Such an operation is often necessary, even though quarter panels and/or other parts are to be replaced, in order to align the parts that are not replaced, as well as to provide correctly aligned attachment points for the new parts.

Illustrations, courtesy Blackhawk Mfg. Co.



Many a damaged front fender can be repaired instead of replaced by pulling out the deformed metal by means of the simple hook-up shown here.



It is often difficult to get at the deformed ends of wrap-around bumpers with conventional equipment, but by using this new method of force application, it is easy to pull them back.

For some pulling operations, where somewhat lighter equipment can be used, the mechanical Pull-dozer can be used. This model uses the same principle of operation that makes the hydraulic model so valuable.

How you can sell seat covers profitably

By VERNON VOLLAND
Executive Director
Automobile Seat Cover Association
of America (ASCAA)

• AUTOMOBILE SEAT COVERS can mean a harvest of fat extra profits for the average independent service shop.

With more people than ever before trying to "make do" with their old car, the market for seat covers is steadily expanding. At the same time, a national publicity and advertising campaign is making the motoring public "Good Car Keeping" and seat cover conscious.

The independent shop owner can seize on both of these trends to add a sure-fire profit-maker to his business with a minimum of investment. Also working in his favor is the national "Good Car Keeping" promotion sponsored by the Automobile Seat Cover Association of America, which has taught the public that attractive seat covers beautify a car and enhance its value.

No large investment for inventory is needed to get into the seat cover business; no big outlay for expensive tools or machinery need be made. The average service shop employee can quickly learn to do a professional job of seat cover installation; no expensive training or hiring of additional help is necessary. Only a minimum of valuable floor space need be set aside for an eye-catching seat cover display. No special physical set-up is needed for installation of seat covers.

And finally, seat covers are a natural sideline for the independent shop owner. All his customers are car owners and therefore potential seat cover buyers!

What kind of profits can be expected from seat covers? If to avoid carrying an inventory, the shop owner buys his seat covers from a retailer, he can expect a 25 per cent gross profit. Under this arrangement the seat cover retailer acts as a jobber and sells the covers to the shop owner at a 20 per cent discount from the retail price. Add to this a $5 installation charge and the shop makes a neat profit.

Buying from the manufacturer will almost double the profit. Most manufacturers sell in quantities of a dozen or more and a relatively few basic seat cover patterns will now fit most of the cars on the road. Special orders can be filled by a jobber. Buying from a jobber is the best bet for the shop owner who doesn't want to bother keeping a stock of seat covers on hand.

For example, the manufacturer charges the jobber $10 for a cover that retails for $19.95. The jobber will in turn charge the shop proprietor approximately $14.00 for the seat cover, who will sell it for $19.95 plus a $5 installation charge. In some areas, the installation charge is included in the seat cover retail price while in others it is added on. Of course, pricing will be determined by local conditions.

The shop owner who sticks to the $19.95 retail price will make a net profit of about 25 per cent on covers bought from a jobber and 40 per cent on those bought from the manufacturer.

The shop's men can easily be taught to install seat covers. Generally it takes two men a half hour to do the job. Average labor cost for installation is $2.50 a set. Although one man can install the covers in approximately an hour's time, it is best to have a two-man team do the work.

The only tools needed for seat cover installation are a hog ring pliers, a Phillips screwdriver, a long bench or table and hog rings. Most of these items are already on hand in the average shop. No more than $10 need be invested in additional equipment.

A display rack with miniature seats covered in several seat cover styles—which makes a very effective selling tool—can be obtained for about $25. A stock of five or six basic patterns and colors will satisfy most customer demands. Innovations in seat cover materials make it possible to fit about 75 per cent of the cars on the road with six basic patterns.

There are more than 15 basic styles on the market. These in turn are available in more than 20 designs and in hundreds of combinations of color, material, design and pattern.

The ASCAA suggests that seat cover colors be chosen to harmonize with the car's exterior. Here are some of the seat cover materials in widespread use:

Clear plastic, popular for new cars. It protects original upholstery and shows it off. These covers retail at $25-$35 a set.

Plastic saran, durable, water and stain resistant, easily cleaned with a damp cloth. Woven from plastic fibers, these covers come in a wide variety of colors and patterns. They retail at $25-$50 a set.

Fibre, made of tightly twisted natural fibre, water resistant and color fast. This is the coolest seat cover of

From left: Place cover over seat (if upholstery is damaged, pad first with cotton); stretch tightly, smoothing out wrinkles; turn seat and clamp cover fringe.

all. Covers of this material retail at $15-$25 a set.

Rayon, woven synthetic yarns with colors already in them to resist fading. These covers retail at $25-$50 a set.

Puffed saran, a luxury fabric of woven plastic, puffed up to give a plush look, sometimes interwoven with sparkling metallic threads. Retail price of these covers is $30-$50 a set.

Vinyl fabrics, used for total cover as well as trim. Comes in embossed patterns in combination with synthetic rubber foam. Retails up to $100.00.

INSTALLATION POINTERS

The important thing to watch in installing seat covers is a tight fit. Cover every contour without bulges and keep the seams straight. Before installing the covers, clean the original upholstery with a good cleaning fluid. Here are a few tips on overcoming some of the installation problems you may run into:

If the front seats are so close to the floor that there is no space for the hog rings used to fasten the seat cover, use metal clips.

To cover single piece back seats where the back cannot be separated from the seat, force a heavy cardboard tube into the crevice between the back and the seat. It stretches the cover into a tight fit.

Generally four simple steps are all that is needed to install the average set of seat covers:

1. Stretch the cover taut over the seat. If the original upholstery is badly damaged, place a cotton pad over the seat first. It's best to have two men do this to insure a tight fit.

2. Turn the seat over and attach the seat cover fringe to the underside of the seat with hog rings, using hog ring pliers.

3. Turn the seat back to its normal position and inspect the job for wrinkles, misalignment and sagging.

4. Replace the seat in the car.

And that's all there is to seat cover sales and installation for the independent service shop.

It's a simple process that requires no great outlay of capital or expensive training. The average shop need add no more space to handle seat covers, and most of the tools for doing so are already in the shop. It's a profit-making natural!

Marine Engine Service Stressed by Auto-Lite

To meet the demands for marine servicemen well versed in the outboard and inboard marine engine electrical systems, The Electric Auto-Lite Co. has prepared a special training course for marine servicemen that thoroughly grounds the apprentice in the whys and wherefores of servicing marine electrical systems. For the veteran, it serves as a refresher course that brings him up to date on latest product and servicing developments.

Modeled after the Auto-Lite Field Technicians Training Course for automotive servicemen, the Marine Training Course covers the electrical system from atoms to anodes in two basic manuals that become the students property; 60 large diagrammatic charts of the various circuits; color films; demonstration parts and other training aids.

The basic course manuals cover: Fundamentals of Electricity and Magnetism; The Marine Starting Circuit; The Marine Ignition Circuit and The Marine Charging Circuit.

The training, which is free to students, is designed for evening courses that can be scheduled conveniently for area servicemen so that they do not lose time on the job nor time away from home because the school comes to their hometown area.

★ ★ ★

There are 706,000 automotive businesses in the United States. This amounts to one out of every six businesses in the nation.

EIS ASSORTMENTS
create "One-Stop" brake service, build traffic, increase profits!
From "popular-price" counter cabinet assortments to "king-size" floor models, you'll find that EIS Repair Kit and Cylinder Assortments are just the thing to speed brake service. Each assortment cabinet is "tailor-made" to fit individual trades — all of them have plenty of space for expansion. Order an EIS Assortment today, because any EIS Assortment is a time and money-saver to any brake serviceman!
* AK609-8 "POPULAR-PRICE" ASSORTMENT
Contains 7 Master Cylinder Kits and 20 Wheel Cylinder Kits. A minimum stock for maximum coverage. Can be expanded to hold 20 Master Cylinder Kits and 40 Wheel Cylinder Kits. Quick-Reference Chart on top makes an attractive, colorful selling sign.
* AK-1
Approximate capacity — 25 Master Cylinder Kits, 112 Wheel Cylinder Kits, 32 Hoses and 30 Switches. Larger repair kit and cylinder assortments are also available.
* AC-1
Approximate capacity, 25 Master Cylinders and 80 Wheel Cylinders.
NOTE:—AK Cabinet is designed to ride "piggy-back" on AC Cabinet. They fit together to provide extensive coverage.
EXPANDER CUPS
A222 "E" Series CUP ASSORTMENT
Contains 84 sets of "E" Series Cups, Expanders and Springs – ¾" - 1½".
* These cabinets feature automatic stock-check labeling — provides immediate inventory control.
EIS BRAKE PARTS
Write for Catalog No. 26H-18 — EIS AUTOMOTIVE CORP., Middletown, Conn.

These are new *manufacturers' products*

HOW TO GET RUSH INFORMATION

If you want further information or literature describing the products shown in our "These Are New" pages, just use the handy Business Reply Card you'll find further back in this issue. Whether you want information on one or more of the products, all that is necessary is to mail this Postage paid card properly filled out to AUTOMOTIVE SERVICE DIGEST. Our Reader's Service Dept. will contact the manufacturers directly and see that you obtain the requested information as quickly as possible.

Brake Drum Grinder

A new, low cost, brake drum grinder for use with the Ammco Model 3000 "Safe-Turn" brake drum lathe, is announced by Ammco Tools, Inc.

The grinder mounts in place of the

boring bar, and when not in use, can be stored out of the way in a special storage rack.

According to the manufacturer, smooth, fast and powerful grinding action is supplied by a ½ h.p. positive drive motor. It is completely ball bearing equipped, permanently lubricated and comes complete with diamond dresser, tool tray, storage rack and grinding wheel.

(Circle No. 1 on Reader Service Card)

Hydraulic Jack Oil

Jack-Pack Mfg. Co. announces a new hydraulic jack oil designed specifically for use with their hydraulic jack repair kits. Complete illustrated instructions for properly filling and bleeding any hydraulic jack is contained on the back of every can, an important feature, according to the manufacturer, because of the fact that if proper oil level is not maintained the jack will not work properly.

(Circle No. 2 on Reader Service Card)

Stoplight Switch Assortment

The Automotive Division of Wagner Electric Corp. announces a new stoplight switch assortment which contains hydraulic and mechanical switches for popular cars and trucks, including

new models. Twenty-six switches are included in the assortment, with extra switches included in the more popular numbers.

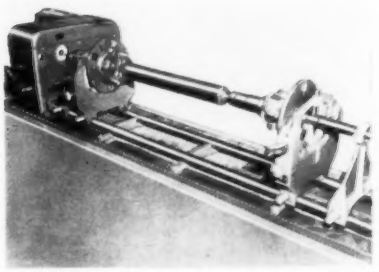
Switches are stocked in a colorful red, white and blue merchandising carton to facilitate easy selling. In addition, application data is printed on the reverse side of the card.

(Circle No. 3 on Reader Service Card)

Driveshaft Balancer

Engineered to accommodate a length of 90" between work supports, a new machine to dynamically balance all types of driveshafts has been announced by the Bear Mfg. Co.

Primarily designed for passenger car, truck and bus driveshafts, the



new balancer will handle any other type that can be adapted to the master accessories and weight capacity of the machine. Accessories include master plates for flange end yokes and spline arbors for spline end yokes.

The machine can also be used for the single plane balancing of individual companion flanges, flanged yokes and end yokes, if desired.

A range of from 0 to 3,000 r.p.m. is obtained through use of a variable speed drive while a brake provides a smooth, quick stop for the rotating body.

Precision dial indicators determine the amount of unbalance and a strobe light is used to indicate the location. According to the manufacturer, this balancing method is so simple that any shop personnel can be trained to operate the machine in a few minutes time.

(Circle No. 4 on Reader Service Card)

Transmission Sealer

An automatic transmission sealer and conditioner is being offered by the Rust Master Chemical Co. that is said to soften and make flexible dried, hardened or shrunken rubber transmission seals, cut gear wear, prevent deposits and help absorb condensation by-products.

Known as "Trans Master," the manufacturer states that the additive should seal leaks after 100 miles of driving.

(Circle No. 5 on Reader Service Card)

Cell Prodding Eliminated

A new Model 200 Battery Supertester is announced by Fox Products Co. which is said to permit fast, easy over-all testing of 6/12-volt batteries

through leads that clamp to battery posts, thereby eliminating individual cell prodding.

According to the manufacturer, the new unit checks: (1) the amount of charge in the battery (open circuit); (2) the condition of the battery (under built-in load): (3) the car charging system—each check being indicated on a separate, expanded scale.

Discharge load supplied by the unit is 90 amps for 12-volts and 180 amps for 6-volts.

(Circle No. 6 on Reader Service Card)

New Tubeless Tire Repair Unit

A new automatic self-vulcanizing tubeless tire repair unit is announced by Remaco, Inc., which is said to be the most efficient, simplest and easiest method of repairing tubeless punctures "on the wheel" yet designed; producing a cold vulcanizing repair to permit recapping of the tire.

The disposable repair unit contains

in its metal construction a compressed rubber plug and a self-piercing double-action cartridge of cement. A simple push automatically supplies a first lubricating shot of cement, inserts the plug and supplies a second sealing shot of cement. The empty metal housing is then withdrawn and disposed of—no guns, injectors or inserting tools or wires . . . no messing around with cement. After first reaming the puncture channel (approximately 1 minute required) the Rema Automatic, so the makers claim, will complete the repair within 3 to 5 seconds, with the tire ready for immediate use.

(Circle No. 7 on Reader Service Card)

"Nut-Buster"

To take the hard work out of shock absorber replacement, The Gabriel Co. is now offering a "Nut-Buster" which is said to instantly free frozen

nuts from rusted or corroded stud-end shock absorbers.

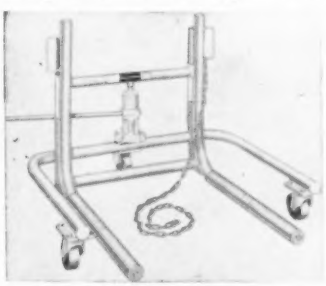
Made of special alloy steel, it operates with an ordinary socket and ratchet. A few turns of the driving head is said to split the nut so that it can be removed with little effort... with a bite on each side, the nut falls off in two pieces.

(Circle No. 8 on Reader Service Card)

Wheel Dollies

A complete line of mechanical and hydraulic wheel dollies for removing, replacing and lifting heavy single or dual truck and bus wheels, is being offered by the Blackhawk Mfg. Co.

Every Blackhawk Dolly has large

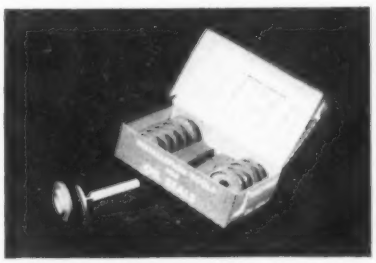


4" swivel wheels and three-point suspension for extra maneuverability on asphalt or uneven, rough floors or pavement. A specially designed leveling adjustment screw on every unit allows the rear wheel to raise or lower two inches to perfectly align the wheels to the axle shaft. The complete line is constructed of strong steel tubing and have roller lifting arms which allow the wheels to rotate for quick positioning of bolt holes.

(Circle No. 9 on Reader Service Card)

Oil Seal Installation Tool

A new oil seal installing tool, designed to assure accurate installation alignment and prevent seal damage when installing the front wheel seals on cars and light trucks, is now available from Federal-Mogul Service.



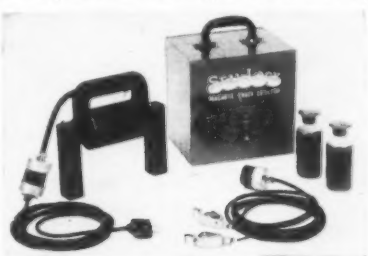
Basically the new tool consists of a knurled, "no-slip" handle which screws into a rugged backing plate. Both are made from tough, high carbon steel which will withstand sustained heavy pounding. The adapters, made from tough plastic, slip instantly onto the backing plate.

The tool is supplied with National Oil Seal cabinet service stocks at no extra charge and includes the basic tool, ten plastic adapters, and a sturdy, grease-proof case with a built-in application selection chart which shows the proper seal and adapter to use.

(Circle No. 10 on Reader Service Card)

Magnetic Crack Detector

A new, low cost, completely portable crack detector is announced by The United States Casting Repair Corp. which uses the magnetic particle inspection principle for locating and outlining any surface crack or fault on any ferrous casting, such as blocks,



heads, shafts and transmission cases.

The unit weighs only 20 lb. and is easily operated by one man. It can be operated from either a 110 A.C. line, 12-volt or 6-volt battery—an added versatility that makes crack inspection possible in areas where electrical lines are either unavailable or not permitted.

The unit includes probe, A.C. and D.C. connectors, sprinkling bulbs, grey magnetic powder, yellow magnetic powder and complete operating instructions, contained in a sturdy steel carrying case.

(Circle No. 11 on Reader Service Card)

These are new *manufacturers' products*

Governor Only 1" Thick

Hoof Products Co. announces a new very thin velocity governor for Ford trucks, school buses and passenger cars equipped with two-barrel carburetors as well as any other makes of

engines using the "X" type dual carburetor.

Only 1" thick, it possesses all of the Hoof patented features of a spark advance transfer mechanism, diaphragm anti-cheat device, and cantilever spring. Quality bearings are used throughout to eliminate friction wear and assure long life.

(Circle No. 12 on Reader Service Card)

Exhaust Pipe Cutter

A new tool, designed to quickly cut through exhaust pipes, tailpipes and muffler connections, even in hard to reach areas, has been announced by the Lisle Corp.

The new device, called the MT-3

Muffler-Tailpipe Cutoff Tool, features four exclusive knife-edged cutting wheels which cut the pipe when rocked back and forth through just one-third revolution.

A threaded handle makes fitting the tool to the pipe and keeping tension on the cutting wheels as easy as opening or closing a simple "C" clamp.

(Circle No. 13 on Reader Service Card)

Fish Eye Eliminator

An additive for all lacquers and enamels that is said to eliminate fish-eyes and cratering in touch-up, panel repair and complete refinish jobs is announced by the Du Pont Company's Finishes Division.

Called Du Pont Fish Eye Eliminator, it is a crystal clear material, packed in capsules . . . each capsule containing a measured quantity sufficient for one pint of thinned paint. Fifty capsules are packaged in a transparent plastic re-usable container.

(Circle No. 14 on Reader Service Card)

Touch-Up Paint in Aerosol Cans

A complete line of car-matching colors in aerosol lacquer enamels for the 1957-'58 Ford, Chevrolet and Plymouth automobiles is announced by Plasti-Kote, Inc.

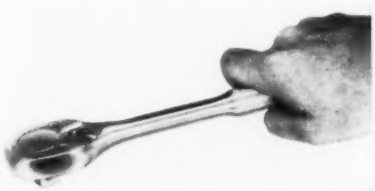
The 8 oz., push-button cans have large cover caps painted in color of contents for quick identification, and cans are coded on bottom for proper identification should cap be misplaced.

The lacquer enamels are fast drying, and the manufacturer states they can be used on any surface.

(Circle No. 15 on Reader Service Card)

Reversible Ratchets

The Owatonna Tool Co., announces a completely new line of light-weight, trouble-free reversible ratchets with small, compact heads and a simple visual shift lever which is said to be



easy to disassemble and repair in the field, should the need arise.

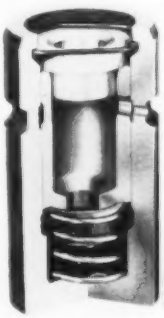
The small, compact ratchet head is said to easily fit into tight places; the reversing mechanism being controlled by a visual positive-control shift lever located on the neck of the wrench.

Made from highest quality alloy steel and heat treated for maximum strength and wear, the ratchets are available with drive end sizes of ¼", ⅜", ½" and ¾". Each ratchet has 24 teeth, round knurled handle and high-polished nickel-chrome finish.

(Circle No. 16 on Reader Service Card)

Hydraulic Valve Lifters

A new line of hydraulic valve lifters is announced by Toledo Steel Products, engineered to meet the critical requirements of modern engines and to give maximum trouble-free performance with minimum attention.

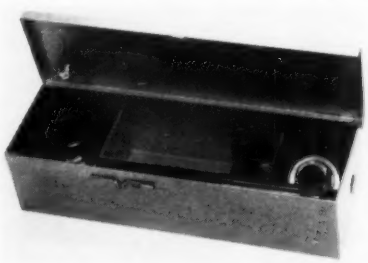


The line features simplified design of internal parts, as well as new materials, finishes and coatings selected to withstand greater valve spring loads, higher valve lifts and faster operating speeds. Lifter materials are matched to those of the cam shaft for compatability and long life. The face is specially coated for anti-scuffing protection, and a special check valve prevents loss of lift to assure precise timing. Each lifter is furnished prefilled with rust inhibitive fluid and each is performance tested.

(Circle No. 17 on Reader Service Card)

Rod Pin Inserter

A new Sunnen Pin Inserter (model B-190) is now available to assemble and disassembly all press-fit type connecting rods used in Chrysler Corp. engines through 1958. Also being of-



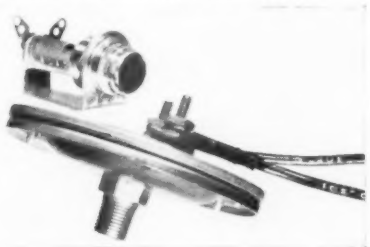
fered is a new adapter set (B-60) to be used with the company's present B-12 Pin Inserter to assemble and disassemble press-fit rods on all 1958 G.M. and Ford Motor Co. engines. An adapter set is also available for American Motors engines.

The Pin Inserters remove the wrist pin in one operation and reassemble the piston, rod and pin in one operation. According to the manufacturer, piston will not collapse or rod will not cock during assembly, and a positive stop automatically centers the rod exactly between piston bosses to eliminate guess work.

(Circle No. 18 on Reader Service Card)

Air Cleaner Warning System

A new air cleaner warning system for use with the dry-type air cleaner, is announced by the McQuay-Norris Mfg. Co. Developed in co-operation with auto and filter companies, the system consists of a sensitive vacuum switch that actuates a dash light when



the cleaner becomes clogged and excessive vacuum builds up in the intake manifold.

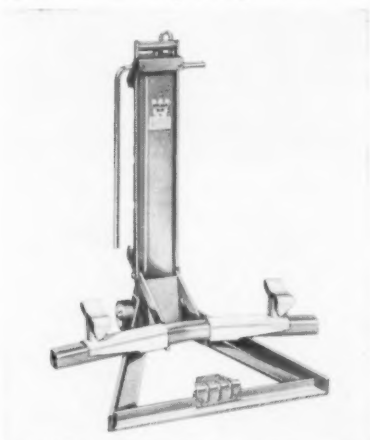
The switch is housed in a lightweight aluminum housing, completely resistant to corrosion, dirt, water and oil, and is said to be guaranteed to function properly even under the most severe vibration encountered in normal engine operation.

It can be mounted in any position, by means of a ¼" male threaded pipe boss. The switch has been proved reliable in all temperatures up to 250°F. Adjustment can be made within the vacuum range of 5 to 30 in. of water, either at the factory or in the field.

(Circle No. 19 on Reader Service Card)

One-End Hydraulic Lift

A new one-end hydraulic lift, designed to lift all passenger cars and



light trucks, is announced by Walker Mfg. Co.

Known as the No. 99, the new 1½-ton lift features variable bumper clearance to lift all of today's low-slung, long-overhang automobiles. Because of Walker's exclusive wide angle V-beam design, the distance between bumper and jack increases from 9½" to 15" as saddles are spread, which is said to eliminate "dinged" or distorted bumpers.

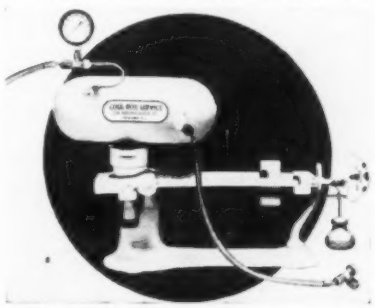
Lifting saddles rotate in a full circle to assure a firm, safe contact, and saddles adjust from 24" to 43". Twin safety locks protect load and operator from accidental lowering.

A front caster wheel provides "tricycle" maneuverability ... deflects under load to allow the full V-bar base to contact ground or pavement.

(Circle No. 20 on Reader Service Card)

Refrigerant Scale

According to Cool-Rite Service, charging the automobile air-conditioning system can be handled more quickly and accurately, without loss



of refrigerant, when the refrigerant is weighed instead of measured.

To facilitate this service, they are offering a scale especially designed to weigh both liquid and vapor refrigerants to within one-eighth ounce accuracy. According to the manufacturer the necessity for calibrating a glass or checking frostback is eliminated; there are no electrical connections, and the scale is unaffected by temperature or pressure.

(Circle No. 21 on Reader Service Card)

Elevating Tailgate

A complete line of new electric-hydraulic "Weightlifter" elevating tailgates in a choice of 1000, 1100, and 1300 lb. capacities for use on pickups, on through ¾ and 2-ton trucks with

stake or van bodies, is announced by the H. S. Watson Co.

Power platform closing to the vertical riding position is standard on the 1100 and 1300 models. One control lever—and one hydraulic cylinder—controls all functions of the tailgate, with a "safety control stop" built in.

According to the manufacturer, the largest Weightlifter in the line will sell for under $550, and can be simply installed by any shop mechanic.

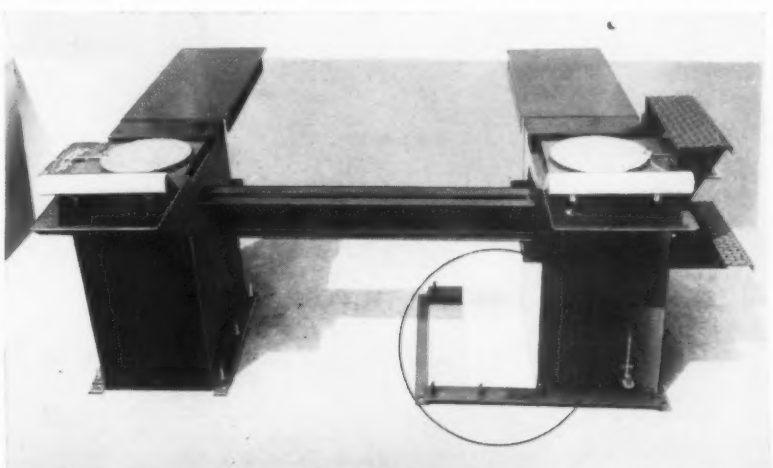
(Circle No. 22 on Reader Service Card)

Adjustable Alignment Rack

The J. H. Bender Equipment Co. has developed a new line of "roller bearing mounted" adjustable alignment racks that are "quick-set" to take on small foreign and sport cars as well as the larger American cars and pickups.

"Adjust-Easy" racks are available in floor models and the pit model as shown here. They feature roller bearings mounted under the movable side that rolls effortlessly back and forth on guide rails (circle) to accommodate tread widths from 38" up to 62". An opening on the movable side allows the crossbeam to telescope in and out. Shops owning a Bender stationary-type rack can conveniently convert it to an "Adjust-Easy" type by merely exchanging the legs on one side.

(Circle No. 23 on Reader Service Card)



These are new *manufacturers' products*

Heavy-Duty Wheel Balancer

A new heavy-duty, on-the-vehicle truck and bus wheel balancer is announced by the Hunter Engineering Co., featuring tune-in control-knob wheel balancing, pioneered by the company for passenger cars and medium trucks.

A new universal adaptor cuts bal-

ancing "get-ready" time to a minimum, and fits practically any size and type truck wheel—cast or disc. Lug bolts do not have to be removed for mounting on most wheels, but lug anchors are furnished for those wheels that require them.

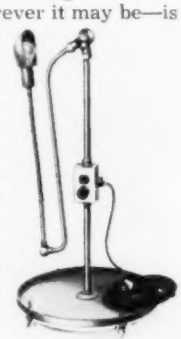
Wheel spinners are available in either 4 or 8 hp. models, and are said to spin even the biggest wheels up to 100 m.p.h. Single-lever control operates spinner . . . pull handle up to spin wheel, push down to brake wheel . . . and a rear-mounted, foot operated motor control allows operator to spin wheel while standing.

Large rubber wheels permit easy handling; removable handle permits compact storage. Water-tight storage compartment, with self-fastening protective lid, keeps weights, tools and accessories safe and dry.

(Circle No. 24 on Reader Service Card)

Shop Lamp Stands Alone

A new type of shop lamp which is said to provide direct light on the working area—wherever it may be—is announced by The Vimco Mfg. Co.



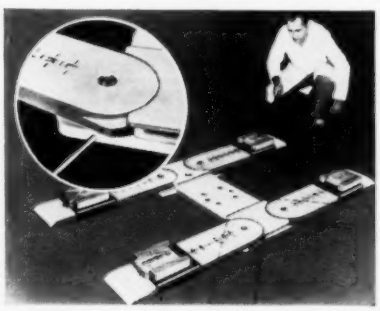
The rigid, upright light standard of the "Vimco 9000" is 36" from the floor to the center of a large swivel joint and is based in a heavy non-tilt, four-castered platform. Its flexible arm may be placed in any position—and its porcelain keyless socket is housed in an assembly that rotates 360° continuous, without movement to the porcelain socket or wiring. The unit's duplex receptacle of heavy cast aluminum, provides a toggle switch for lamp control, plus an outlet for plugging in of power tools or accessories.

The lamp is fully grounded and the wire adaptor plug permits grounding when used with two wire ungrounded feeder service. Folded height is 39", full verticle height from the floor is 98" and the full horizontal extension is 62".

(Circle No. 25 on Reader Service Card)

Pre-Set Feature Speeds Lifting

A pre-set adjustability feature in Globe's latest "Frame-Kontact" hoist permits mechanics to pre-set the hoist's swivel arms and sliding contact pads to the recommended undercar lifting pattern without reaching or



"feeling around" under the car before raising the vehicle.

The superstructure of the hoist consists of four 31" long, 8" wide, 1½" thick swivel arms attached to the cross member by a tongue-in-groove swivel connection. The sectionalized, sleeve-mounted contact pads may be moved along a graduated scale on the swivel member; the hinged center section of the pads being adjustable for two upward positions. A maximum longitudinal reach of 87" plus a maximum width adjustment of 78" is said to provide adequate undercar contact range to handle all U.S. and foreign cars, including panel and pickup trucks.

(Circle No. 26 on Reader Service Card)

Foreign Car Filter Refills

Oil filter refills for most foreign cars are now being made available by Purolator Products Inc. One of the most recent additions to the line, for example, is the P-70FR refill for the Borgwald Isabella. Another recently introduced Purolator refill, the MF-35, is designed as the proper replacement element for the British Ford, Consul 4-cylinder and Zephyr 6-cylinder.

The Alfa-Romeo, 1956-58 models, takes the Purolator P-10L, and the Aston Martin, 1954-58, uses refill MF-52A. The long list of cars which also use Purolator refills includes, Austin, Fiat, Hillman, Humber, Jowett, M.G., Morgan, Porsche, Riley, Singer, Standard, Sunbeam Talbot, Triumph, Vanguard, Vauxhaul, Volkswagen, and and Volvo.

(Circle No. 27 on Reader Service Card)

Tool Features Dustless Sanding

A new 3" heavy-duty belt sander is announced by The Black & Decker Mfg. Co. which is said to be suited to both synthetic resin and lead methods of body refinishing and repair. The unique feature which makes this possible is *dustless* sanding—the all-new Dustless Belt Sander attaches to any standard industrial or domestic vacuum cleaner to eliminate over 90% of the paint-dust and fine metal powder. According to the manufacturer, this exclusive dustless feature provides longer belt life, with cleaner, more

healthful working conditions; and it permits sanding to be accomplished in the same area where painting is being done.

The tool is built for continuous, heavy-duty use. It is driven by a special B&D motor to deliver a sanding power of 1600 surface feet per minute. A foolproof timing-belt-drive provides smooth, quieter operation and requires no lubrication, thus eliminating danger of grease-drip on the work surface. Other features include a flush side that permits accurate sanding up to any vertical surface; extended front pulley for work on contours and small radii; a convenient tracking knob and large front knob for optimum control; and proper balance for less operator fatigue.

(Circle No. 28 on Reader Service Card)

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●ONLY ASD provides the automotive service field with timely, authoritative, detailed articles of this type. Prepared by men who have the actual experience, as well as the education to "live with" the increasingly specialized service needs of the modern automobile, these features go deeply into the methods and mechanical parts involved. Most "Tech Know-How" write-ups are step-by-step "how-to" descriptions of the latest procedures in a key servicing operation.

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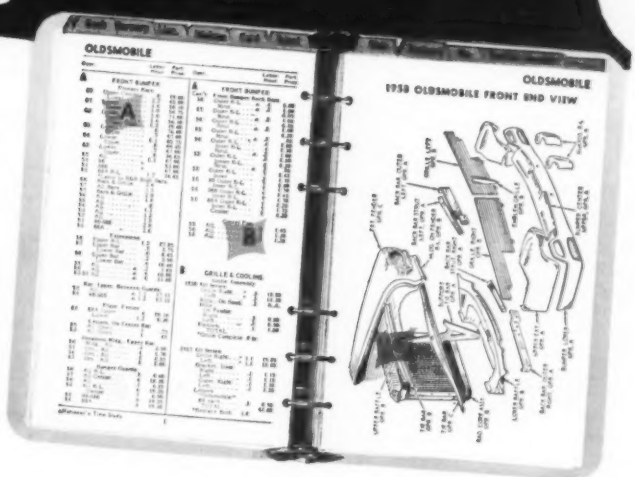

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These are new *manufacturers' products*

Remote Circuit Control

A simple to operate, easy to install 5½′ long remote circuit control is being offered by the H. H. Hickman Co. which enables the shopman to start and stop an engine without using the ignition key.

Examples of the tools usefulness, as given by the manufacturer are: starts

an engine without ignition keys; permits intermittent turn-over of engine; allows for continuous turn-over of engine without engine firing; acts as a flashlight; locates blown fuses; checks electrical equipment; locates broken circuits; by-passes any switch; serves as a test lamp; acts as a direct switch and also as an intermittent switch. The device may also be used to check generators, with the use of an ammeter, and for checking voltage regulators.

The strong, custom-made cable and control parts are protected against accidental short circuits by a compact fuse element, easily accessible and replaceable. The corrosion resistant chrome housing is enclosed by oil-resistant neoprene mounts, and lens and lamp are encased in one neoprene mount to prevent breakage.

(Circle No. 29 on Reader Service Card)

Power Pack for Outboards

The new Exide Power Pack for 6- and 12-volt outboard motors is built in the form of a carrying case for the battery, and serves numerous other functions.

There is a built-in charger that can be plugged into a 110 A.C. line to recharge the battery. The entire unit clamps to the deck, to avoid movement in rough seas and vibration damage to the battery. A compartment is provided for tools, etc.

A convenience outlet in the side provides a source of 6-volt or 12-volt power for lights, radios and other types of remote outdoor use.

(Circle No. 30 on Reader Service Card)

Safety Bumper Jack

A new type bumper jack designed to provide maximum safety in the jacking of all cars, especially the newer models equipped with air suspension, is announced by The Universal Tool and Stamping Co., Inc.

According to the manufacturer, the

new jack offers owners a safe and secure lift for many jacking conditions normally considered hazardous, such as: gravel roads, rough berms, uneven ground, etc.

Construction consists of two heavy-duty, formed steel safety legs, connected to the center weight carrying jack bar by two non-slip, rigid spreader bars. In normal use the center jack bar supports the full weight of the car. However, should the car slip or sway in any direction, the safety leg or legs supply the needed support to prevent the jack from slipping off the bumper. The two safety legs combine with an oversize base plate to provide positive, firm support.

Further safety is afforded with a new dual type lift hook design that permits a snug and safe fit on every type of bumper. For late model cars, the curved section of the swing lift hook wraps around the underneath side of the bumper providing a positive lock. For other models the bumper rests securely on the top flat section of the lift hook.

A permanently attached folding handle and the hinged spreader bars permit folding for compact storage.

(Circle No. 31 on Reader Service Card)

Top and Interior Refinisher

A new chemical spray in 14 mix-'n-match shades, that is said to make possible the complete reconditioning of soiled interiors and convertible tops of used cars in minutes is now being offered by the Taussig Co.

It is emphasized that the product is not just a cleaner, but that it leaves a

perfect finish said to equal the original beauty.

According to the manufacturer, "'Lasticolor" does not change the texture of plastic, nylon, leather, rubber, cotton, wool, rayon, leatherette, canvas or practically any synthetic, and is recommended for use not only on automobile interiors but for convertible tops as well, where it increases water repellency.

The new product will not stiffen surfaces and dries smoothly and evenly, leaving no spray marks or "holidays." Treated surfaces remain soft and pliable, and colors applied will not run or fade.

(Circle No. 32 on Reader Service Card)

Steam Cleaner Compounds

A new line of liquid detergents and dry compounds for steam cleaning is announced by the John Bean Division.

Two liquid detergent formulas are available, each in 5, 15 and 55-gallon pails and drums. One is for light to medium cleaning assignments; the other formula for medium to heavy cleaning.

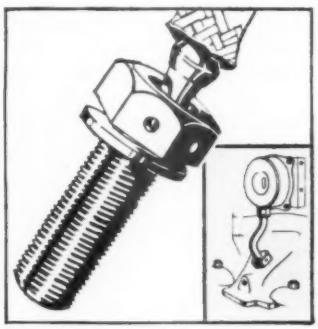
Dry compounds include regular duty formula and heavy duty formula —each available in 100, 200 and 400-pound packages. Emulsifier is available in either a 5-gallon container or a package of six 1-gallon containers for use in speeding up the cleaning of oily and greasy surfaces. Also available is a dry acid coil cleaner for descaling steam cleaner coils.

(Circle No. 33 on Reader Service Card)

Choke Tube Repair Kits

To simplify service and inventory, Houser Engineering & Mfg., Inc., is now offering two low-cost, easy-to-install choke tube repair kits designed to overcome and eliminate sticking chokes on all '56 to '58 Ford, Chrysler and GM cars.

Up to now, the unavoidable burning



out of choke heater tubes, mounted through intake manifold required major time and labor charges for removal of the manifold plus repeated replacement at intervals. Burned-out manifold heat tubes caused exhaust gases to circulate through the automatic choke unit, creating carbon formation and resulting in sticking of the choke.

According to Houser, their choke heater replacements will never burn out . . . the heat element is simply screwed into the manifold, the copper line seated in it, the top of the line then inserted into the automatic choke inlet and secured with a nut. The burned-out choke heater tube is simply plugged, pinched and left in place.

(Circle No. 34 on Reader Service Card)

Bushing Replacement Tool

This tool is designed for quick bushing and bearing removal and replacement without marring them. It can be used on connecting rod upper ends, steering knuckles, small gasoline engines and multiple bearings (camshaft, for example) with oil holes correctly lined up in the rod, block, etc.

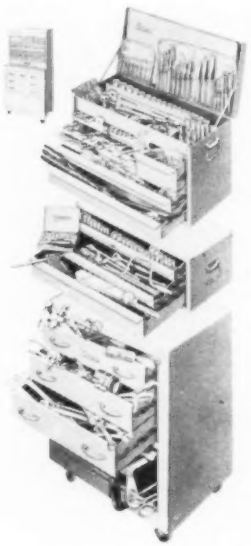
For con rod bushing removal, the tool base is placed on a press seat and new bushing slipped over lower end of the tool, the nipple of which is placed in the base. The con rod is placed over upper end of tool along with the guide washer. The assembly is aligned in the press and the press plunger pushing the upper sleeve forces out the old bushing, leaving it on the upper part of the tool. Continued pressure forces the rod over the new bushing as the rod settles on the tool base.

According to the maker, Hamilton Tool Co., six rods can be rebushed in from two to three minutes.

(Circle No. 35 on Reader Service Card)

General Purpose Tool Set

A new general purpose set of 232 tools, complete with tool chest, drawer section and roll-cab is now being offered by Snap-on Tools Corp. Each



tool is of top quality and is designed for regular use in day-to-day service and repair work.

The tool chest and drawer section are standard, as shown; with other drawer arrangements available if desired. A raised rim around the roll-cab top and corner retainers on the drawer section hold the three units in place.

(Circle No. 36 on Reader Service Card)

Low Cost Tru-Charger Line

An entirely new, low cost Tru-Charge line of 6- and 12-volt fast battery chargers has been announced by Allen Electric and Equipment Co.

The new line offers a wide selection of three wheeled and two portable models. Two models are 100/50 amp and include silicon rectifiers; push button controls are offered on three models. All models combine fast and slow charging and can be used as boosters to start stalled vehicles.

The Super "100" has three test circuits including "Rate Finder," a test circuit which shows the highest safe charging rate for each individual battery. All models have down draft forced air ventilation, heavy duty transformers and automatic circuit breaker overload protection.

A new 6/12-volt Battery Tester and Merchandiser is also included in the new line with which it is said to be possible to accurately determine the battery condition in five seconds.

(Circle No. 37 on Reader Service Card)

New Paint Spray Outfit

A new, highly portable paint spray outfit featuring a two-quart pressure cup separated from the spray gun, to allow the painter complete freedom of movement while painting, is announced by the Binks Mfg. Co.

With the new "Steadi-Grip" outfit,

the manufacturer states that difficult surfaces can be sprayed easier and quicker, since there is no heavy cup attached to the gun to hinder strokes while painting. At the same time, the danger of paint drip from vent holes is eliminated by keeping the two pieces of equipment separate.

Air and material regulators included with the outfit assure operator of accurate pressure settings necessary to give perfect coverage every time without runs, sags and dusty finishes. The two-quart cup also allows greater area coverage between refills.

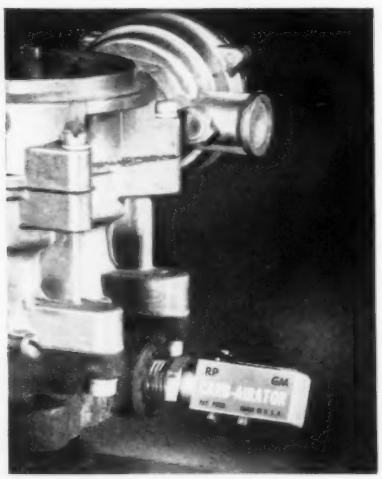
(Circle No. 38 on Reader Service Card)

These are new *manufacturers' products*

Rochester Carb-AIRator

A new automotive device, called a Carb-AIRator, which is said to overcome rough engine idling and stalling caused by high under-hood temperatures, as well as permit easier starting and greater efficiency when the engine is hot, is now being offered by the Rochester Products Division of General Motors.

The unit, when attached to the



carburetor, is said to sense excessively high temperatures and allow extra air to pass through the engine to compensate for the extra richness caused by vaporization. This is done by a thermostatically controlled valve which opens an air bleed to the manifold. The timing of the valve opening can be set by an easy screw adjustment to suit different under-hood conditions. A similar screw adjustment controls the amount of air allowed to enter the engine for different engine displacements. The resultant fuel-air ratio then can be adjusted for normal operation and engine roughness and stalling will disappear. At lower air temperatures the valve closes and the Carb-AIRator is inoperative.

(Circle No. 57 on Reader Service Card)

Graphite in Aerosol Cans

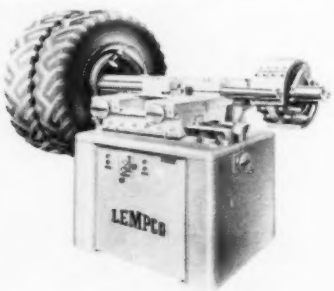
To eliminate the messiness usually associated with handling colloidal graphite, Magnus Chemical Co., Inc., is now offering this black "solid lubricant" packaged in aerosol cans under the trade designation of Magnus Dri-Glide.

According to the manufacturer, when a film of this lubricant is applied to cleaned and disassembled engine parts before re-assembly, engine life is prolonged and additional protection from friction and wear during the critical "break-in" period is provided, allowing piston engines to smoothly "run-in instead of tear-in."

(Circle No. 58 on Reader Service Card)

Dual-Purpose Brake Lathe

Lempco Products, Inc., announces a new "Dual-Matic," dual-purpose brake lathe to fit any budget. The "Dual-Matic," as can be seen in the



illustration, has double-spindle action, cuts brake lining to exact full-surface contact with matching drum, said to be the fastest known method of servicing heavy-duty brake systems at lower material and labor costs.

With this equipment the manufacturer states that only one oversize brake lining need be carried in stock . . . stock removal of drum metal is held to a minimum; linings are turned to match trued drums; there is no brake "wear-in" period, and brake adjustment is simpler, faster, safer.

(Circle No. 59 on Reader Service Card)

New 48" Work Bench

A new, 48" work bench has been announced by Lyon Metal Products, Inc. The bench is 34" high, made in 28" and 34" depths and is available

with plain steel, tempered pressed wood over steel or laminated hardwood top.

Standard bench accessories include shelf, riser, electrical outlet strip, back and end stops, channel type stringer and bench drawers. The finish is durable, green baked-on enamel.

(Circle No. 60 on Reader Service Card)

Low Cost All-Purpose Welder

A new, wide-range, all-purpose, portable 180 ampere arc welder featuring ease of operation and dependable, rugged service, is announced by the Marquette Mfg. Co., Inc.

Known as the Redi-Arc EW65N, the welder has an extra-weight, oversized transformer to provide added efficiency on low voltage power lines, and its full 25 to 180 ampere range

has volt-ampere ratios carefully balanced for each heat stage.

Controls are clearly marked; a simple switchover selects welding amperage. The welding arc is designed for quick starts, surge-free operation and easy handling. It has wide cast-iron wheels and heavy-duty construction.

Sold as a low cost package unit, it includes a full length flexible ground cable; a welding cable with insulated electrode holder; 8' of 3-wire power cable with plug attached; wall receptacle; welding helmet; instruction book and a copy of the company's "Guide to Better Welding."

(Circle No. 61 on Reader Service Card)

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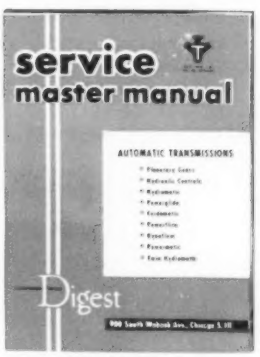
No. 2. Trouble-Shooting Instruments

No. 2. TROUBLE-SHOOTING INSTRUMENTS. Covering all important instruments, including oscilloscopes, used in connection with testing, diagnosis and tune-up operations. Each instrument is thoroughly covered individually to show how it works . . . how it is connected to get different readings . . . how these readings should be used . . . plus specific examples of problem solving.

No. 3. Ignition System Servicing

No. 3. IGNITION SYSTEM SERVICING. Explains the basic principles, theory and application of the primary and secondary circuits, breaker point and distributor operation, testing and servicing. Covers the function of the generator, coil, condenser and how they are related in the ignition system from battery to spark plugs. Detailed tuning and adjusting principles and service of magnetos.



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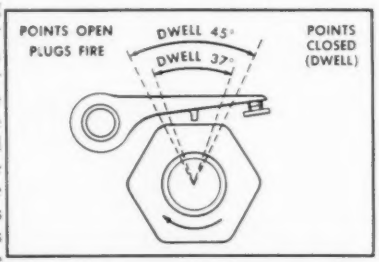
Always Check Ignition Timing After Installing New Points

Even the most experienced tune-up mechanic may occasionally forget that *dwell angle variation directly affects timing,* and he may neglect to check timing after installing a new set of points.

Dwell angle indicates the number of degrees of cam rotation during which the breaker points remain closed. The wider the points are spaced, the less the dwell angle, and visa versa. Since the spark plugs fire when the points open, it's obvious that the earlier the points open, the more you advance the spark timing—it has the same effect as rotating the distributor.



Notice that in the accompanying illustration the breaker points open four degrees earlier when dwell angle is changed from 45° to 37°. The cam, however, rotates at one-half engine speed. Therefore, in terms of crankshaft rotation, the spark will be advanced 8°, same as the total change in dwell.

Because breaker point spacing has a direct bearing on timing, it's advisable to recheck timing after replacing points, and then again after a few thousand miles to compensate for cam follower wear.

When taking a dwell meter reading, it is important that the reading be taken at increased engine speeds, as well as at idle speed. The throttle should be opened and closed suddenly to actuate the vacuum advance mechanism. Quite often, distributor wear, particularly tilting of the breaker support plate, will change dwell angle more than 2-3°, which changes the timing by the same amount.

Long Overhang A Problem When Towing

Reduced road clearance and increased body overhang on today's modern cars have made it difficult to raise one end of the car without having the opposite end scraping the ground. When towing on rough roads, it is quite easy to damage a customer's car because of this factor.

To overcome this difficulty, several car manufacturers recommend that after raising one end of the car, if you are not satisfied that there is sufficient clearance at the opposite end, remove wheels at the towing end and allow car to be towed in a more horizontal position.

Air Conditioning . . . *(Continued from page 39)*

The drier absorbs moisture from the refrigerant vapor. The vapor in turn absorbs moisture from the liquid refrigerant. In this conversion process, if the drier cartridge is allowed to remain in system long enough, it will also partially reactivate or dry out the system's saturated drier.

To remove the drier cartridge, dry eye and tubing from compressor proceed as follows:

8. Back-seat discharge and suction service valves (counter-clockwise).
9. Remove tubing, and drier cartridge assembly from suction and discharge service valves. Replace service port caps.
10. Install flare plugs in tubing ends to seal out moisture.
11. Tighten all connections securely.

TESTING THERMAL SWITCH

Move temperature control lever on instrument panel to "Cold" position. Turn blower switch to "Low" position; car windows and doors closed.

Observe suction gauge pressure. As evaporator temperature lowers, suction pressure will gradually lower and fluctuate down to between 20 and 10 p.s.i. The thermal switch contacts should open and de-energize the clutch. When the clutch de-energizes, there will be a sharp steady rise in the suction pressure.

Allow the system to continue to operate. The evaporator will warm up, thereby closing the thermal switch contacts, which in turn will re-energize the clutch. The suction pressure will again start fluctuating to a lower pressure and the cycle will be repeated.

Should the suction pressure fluctuate down below 10 p.s.i. and then release clutch, it is an indication the thermal switch sensing tube is not making a good contact with evaporator fin and coils. Should suction pressure fluctuate down and on into a vacuum without releasing the clutch, it indicates one or more of the following:

1. The thermal switch wires are shorted together
2. There is moisture in the system
3. The thermal switch is defective

To test evaporator expansion valve for super heat, make sure the air conditioning system is fully charged with Refrigerant-12, and is dry. Make a compressor capacity check and check all the other components for proper working condition.

Install a thermometer (completely insulated against outside temperature) in the expansion valve thermal bulb well. Start engine and adjust speed to 1,200 r.p.m. Place toggle switch in cooling position.

Turn blower switch to high. Open car windows. Feel the heater water valve to make sure no hot water is flowing through heater core.

After operating engine for 10 minutes to allow system to normalize, take reading of suction gauge pressure, and check thermometer temperature. The method used to determine whether the proper amount of refrigerant is metered into the evaporator coils is to determine the number of degrees of super heat the vapor has *absorbed* in the coils. The specifications are 8° to 15° super heat. It is calculated for all models as follows:

EXAMPLES FOR DETERMINING SUPER HEAT

A	B	C	D	E
Observed Suction Pressure at Gauge	Temperature Relation of Suction Pressure	Observed Thermometer Temp. at Evaporator	Corrected Evaporator Thermometer Temp. 5 Deg. Subtracted	Super Heat
25 lbs.	26°	41°	36°	10°
30 lbs.	32°	47°	42°	10°
35 lbs.	38°	53°	48°	10°
40 lbs.	43°	58°	53°	10°

Grateful acknowledgement is made to the Chrysler Corp. for technical data and illustrations received from its Divisions.

When football comes, is winter far behind? No! So quarterback yourself to a more profitable Fall with ASD's October feature article on Winterizing Cars.

Level Checks Car

An ordinary carpenter's level (L) on a straight length of 2"x2" is speeding the checking of car spring sag. Originated for use with air suspension jobs, the idea is proving handy for cars where sagged coil or leaf springs are suspected—front or rear.

Preignition vs. Detonation

The terms preignition and detonation are sometimes interchanged and confused. They are not one and the same, in spite of the fact that one can cause the other.

In simple terms, *preignition* refers to the ignition of the fuel charge before the spark occurs at the plug. It can be started by any overheated surfaces in the combustion chamber—the spark plug, exhaust valve, piston or carbon deposits. Preignition in its mild form results in engine roughness and loss of power. In rare cases, because of extreme temperatures and pressure, preignition can damage the pistons, valves, plugs and other engine parts.

Detonation occurs *after* the fuel charge begins to burn, and its characteristic ping or knock results from the "explosion" of the remaining portion of the gas.

Unfortunately, one of the penalties paid for higher compression ratios and greater power output in newer engines, is increased *tendency* toward preignition. Thus, fuels, lubricants and engine components have had to be more carefully tailored to the new power plants—and the engines themselves have become more critical of improper tune-up methods.

Modifying Engines...

(Continued from page 33)

have the end of the center electrode square with sharp edges; that all cables must have good insulation; that dwell and point condition be good, and that there will be no high resistance points in the secondary circuit, or cross firing any place in the circuit. With these points all taken care of, there will be sufficient available voltage to take care of all ignition requirements. In some cases it may be desirable to use a distributor with two breaker arms to give a somewhat longer dwell period, which will be helpful at very high speeds.

The high test gasoline that is now available at all filling stations will be satisfactory for most conservative or road engine modifications. For hot rod or track jobs, and those for super competition engines, special benzol or alcohol fuel or mixtures may be required.

To be sure that the ignition advance curves are in accordance with specifications, the distributor should be put on a distributor tester and both the automatic and vacuum advance checked, and the distributor corrected, if necessary.

The fuel-air mixture delivered from the carburetor should be checked with a combustion analyzer to be sure that it maintains the best mixture at different throttle positions (particularly at open throttle positions), for good high speed performance and rapid acceleration.

**We are indebted to Automarine Specialists, Chicago, Ill., for their assistance in preparing a number of the accompanying illustrations.*

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More Parts Business
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4 UNITS PLUS CASE $145.00

NEWEST HANSON TESTERS
Simplified hand-size Hanson Engine Analyzers. Hanson quality throughout . . . large 3⅜" x 2⅜" color-coded dials, chrome-plated cases. Ignition tester Tachometer, Dwell Angle Tester and Amp-Volt Generator-Regulator Tester . . . available separately or as 4-unit set complete with carrying case.

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4-color dial reads to 30" of vacuum . . . 7 lbs. of pressure.

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Large dials calibrated to 250 pounds to test all engines.
Standard . . . stem off-set 15° to reach back cylinders.
Deluxe . . . pistol grip houses extra cones and valves.

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V-shaped bracket on back fits every battery cable.

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With adjustable leg to fit both 6 and 12 volt batteries.

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Long-lasting accuracy and brilliant white light. Hand-fitting grips, balanced design for easy handling.
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Deluxe . . . all chrome case, trigger switch, plug-in bulb. Powered from car battery.

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4-UNIT MOTOR TESTER WITH STAND . . $252.95

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Literature:

manuals, catalogs and charts

most items are yours for the asking

ELECTRICAL SPECIFICATIONS . . . The 1958 edition of the AEA Electrical Specifications Handbook gives the necessary adjustment and test specifications on starters, generators, distributors and regulators. This data is listed by make and unit model number and is particularly valuable as a reference when detached units are being repaired or tested. It includes specifications on passenger cars, trucks, tractors, marine, heavy-duty units and those used on off-the-road equipment.

The handbook is priced at $1.25 per copy, and can be ordered from: Automotive Electric Association, 16223 Myers Road, Dept. ASD, Detroit 35, Mich.

(Circle No. 39 on Reader Service Card)

SAFETY EQUIPMENT . . . Newest bulletin offered by R. E. Dietz Co. contains complete listing of '58 laws on vehicle safety equipment . . . gives requirements for automotive lights of all types, reflectors, flares, warning markers, and includes a special section on turn signal regulations.

(Circle No. 40 on Reader Service Card)

AUTO FINISH WALL CHART . . . graphically explaining the "how and why" of automobile finishes and their care, is available from E. I. du Pont de Nemours & Co. Tells what automotive finishes are (differences between lacquer and enamel) and specifies type of finish used by various manufacturers . . . describes causes of finish deterioration, explaining why some conditions make more frequent washing and cleaning desirable . . . discusses stain removal and luster restoration, listing the various types of waxes, polishes and cleaners available with tips on when and how they should be used.

(Circle No. 41 on Reader Service Card)

BATTERY SERVICE EQUIPMENT . . . New 8-page, 3-color catalog describes the entire Fox line of battery selling and servicing equipment . . . including information and specifications on the company's new Superchargers (which charge up to 24-volt batteries) and their deluxe Powercharger line. Also included is description of Fox overall battery testers, automatic pulse maintainers and manually-operated battery maintainers, as well as a complete line of accessories, including booster cables, battery clamps, extension cables, etc.

(Circle No. 42 on Reader Service Card)

GASKETS . . . The 1958 Quick Reference Gasket catalog being offered by Felt Products Mfg. Co. contains all late model listings, with particular attention being paid to making it as simple as possible to use. Confusing footnotes have been completely eliminated — all explanatory information being included with the part number.

(Circle No. 43 on Reader Service Card)

MANAGEMENT DEVELOPMENT . . . Manual of the Independent Garage Owners of America for the retail service trade. Covers fundamentals for success and profit, costs and cost-reducing parts procurement plans. Available from Motor and Equipment Wholesalers Association.

(Circle No. 44 on Reader Service Card)

TUBELESS TIRE REPAIRS . . . Based on exhaustive research and road testing by H. B. Egan Mfg. Co., "The Truth About Tubeless Tire Repair" illustrates with tubeless tire cross sections the difficulties of locating tubeless tire leaks. Included in the folder is a simple, illustrated four-step method of making safe, permanent repairs, and the only two pieces of equipment required are also shown. The folder can be used as a wall chart for ready reference.

(Circle No. 45 on Reader Service Card)

BODY REPAIR MANUAL . . . "Modern Auto Body Repairing" is the title of Black & Decker's 22-page booklet, which describes and illustrates the latest improvements in auto body repairing. It tells of the more familiar metal solder method and the important, new Resin Method, and introduces a new belt sander for the auto body man, which is said to be so dustless in operation that you could paint as you sand.

(Circle No. 46 on Reader Service Card)

ENVELOPE STUFFERS . . . A series of three envelope stuffers are being offered by The AP Parts Corp. which actually are miniature brochures, stressing (1) the profit story of the AP Muffler Specialists; (2) the quality story of AP mufflers, and (3) the special features of AP glass-packet mufflers and duals. Each stuffer tells a complete story and has room for an imprint.

(Circle No. 47 on Reader Service Card)

MUFFLERS AND PIPES . . . Merit's 80-page catalog of mufflers and pipes covers construction features, as well as merchandising programs and installation tips to make muffler replacement easier and more profitable. Listings, including 1958 models, of replacement mufflers and pipes for passenger cars, light and heavy-duty trucks, and farm tractors are in alphabetical order. Also listed are Fiberglas-packed mufflers, dual exhaust systems, brackets and clamps.

(Circle No. 48 on Reader Service Card)

FILTER REFERENCE CHART . . . available from Wix Corp., lists 243 different automotive oil, air and fuel filters and the corresponding replacement cartridges of 14 manufacturers. The 22" x 36" chart features the dimensions of all Wix Filter Cartridges to help the serviceman identify unmarked cartridges.

(Circle No. 49 on Reader Service Card)

IGNITION PARTS . . . for small engines. Now available is a comprehensive catalog of Filko Small Engine Ignition Parts, said to be the first complete listing of these parts available to the automotive trade at full automotive discounts.

Designed for quick, simplified reference, ignition parts listings for all popular makes of engines are sectionalized in a "small engine applications guide" according to type of equipment. Each alphabetized section lists

You may want this information, and most of it comes to you free. Just circle the key number on the Reader Service Card corresponding to the one that appears with the editorial review. Our Reader Service Department will forward your inquiry to the manufacturer or supplier for attention.

the engine manufacturer, his magneto model number and Filko replacement contacts, condenser and coil required for each specific engine. Additional sections offer "comparative code number chart" of original equipment and replacement parts, as well as a "buyers guide section" which illustrates as well as identifies Filko parts for most widely used makes of small engines.

(Circle No. 50 on Reader Service Card)

CARBURETOR GUIDE . . . A new 32-page Carburetor Identification Guide with over 200 illustrations of passenger car carburetors and covering 95% of all exchange units handled, is available to enable repair shops to obtain more positive information on exchange units. The new book contains illustrations. The manual contains a cross reference table converting the original carburetor number to the Champion catalog number. In case a carburetor has no number, it may still be identified by the illustration which indicates detailed differences in similar appearing carburetors.

Write to: Champion Parts Rebuilders, 1314 W. 21 St., Dept. ASD, Chicago 8, Ill.

(Circle No. 51 on Reader Service Card)

SOLDERLESS TERMINALS . . . Vaco's latest catalog includes colorful pages with terminals illustrated in actual size, with schematic drawings, detailed specifications, plus dramatic pictures of new bolt cutter, crimping tool and terminal paks, kits and displays.

(Circle No. 52 on Reader Service Card)

WELDING . . . A 4-page folder (DM-71) describes a combination alternating current, direct current and inert-gas welding machine and gives the advantages of having a welder that will do all three types of welding.

Write to: Hobart Brothers Co., Dept. ASD, Troy, Ohio.

(Circle No. 53 on Reader Service Card)

ENGINE COOLING SYSTEM . . . 45-page, pocket-size manual announced by National Carbon Co., Div. of Union Carbide Co., deals with the operation and problems of automotive cooling systems.

(Circle No. 54 on Reader Service Card)

HAND TOOLS . . . Large, 112-page catalog contains full details of the wide range of shop and mechanic's hand tools offered by Snap-on Tools Corp. . . . Anal-O-Scope engine analyzer; tune-up meters; gauges; testers; automatic transmission tools; wheel aligners and balancers; hydraulic service and body repair jacks; pullers; valve and valve seat grinders; tool chests and tool cabs . . . as well as wrenches, sockets, pliers, screwdrivers, tool sets, punches and chisels—everything the modern shop and mechanic needs.

(Circle No. 55 on Reader Service Card)

MASKING TAPE . . . 4-page folder entitled "How to get Better Looking Repaint Jobs in Less Time", details via text and application photos why the selection of the "right" masking tape helps get repaint jobs done faster and better.

Write to: Dutch Brand Div., Johns-Manville, Dept. ASD, 7800 S. Woodlawn Ave., Chicago 19, Ill.

(Circle No. 56 on Reader Service Card)

Calendar of Automotive Events

1958

Sept. 15-20 — Automotive Electric Assn., Fall Meeting, Broadmoore Hotel, Colorado Springs, Colo.

Oct. 15-18—National Glass Dealers Assn., 1958 Convention, Americana Hotel, Miami Beach, Fla.

Nov. 3-6—Automotive Warehouse Distributors Assn., Inc., National Convention, Muehlebach Hotel, Kansas City, Mo.

1959

Jan. 17-25—Chicago Automobile Show, International Amphitheatre, Chicago, Ill.

Jan. 31-Feb. 4—National Automobile Dealers Assn. Convention and Equipment Exhibition, Conrad-Hilton Hotel, Chicago, Ill.

Feb. 15-17—Motor and Equipment Wholesalers Assn., National Convention, Conrad Hilton Hotel, Chicago, Ill.

Feb. 15-17—Automotive Affiliated Representatives Meetings, Pick-Congress Hotel, Chicago, Ill.

Feb. 18-21—Automotive Service Industries Show, Navy Pier, Chicago, Ill.

Feb. 27-March 8—World Wide Auto Show, Miami Beach Exhibition Hall, Miami Beach, Fla.

March 12-15—Pacific Automotive Show, New Brooks Hall, San Francisco Civic Auditorium, San Francisco, Calif.

May 3-8—Top Management Institute, Motor and Equipment Wholesalers Assn., Allerton House, University of Illinois, Monticello, Ill.

Harvey Jones says: "The radiator business was new to me until I opened my shop. **During the first 9 months I grossed $18,000!** I feel this was due to the excellence of my Inland equipment — plus the instruction and sales aids received at your school!"

Douthit-Carroll-San Chez Co., Memphis, Tenn., averages $300 a week!
Sidney Glass & Rad. Shop, Sidney, Mont., grossed $10,784 in a year!

WANT EXTRA PROFITS? There's a real radiator-servicing opportunity in your area right now — it's growing every day. Every auto-truck-tractor owner is a prospect. Modern cooling-system pressures now are so great that radiators require more frequent servicing.

Inland, world's largest radiator servicing equipment mfgr., offers equipment, training, Pays-For-Itself purchase plan — advertises nationally (Post and Life) to attract radiator servicing business to Inland-equipped shops. Mail coupon today.

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Factory school trains you or your man quickly: cleaning, repairing, recoring, resectioning, everything!

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Please send new free book, "Blue Print For Profits."

FIRM _____ (PLEASE PRINT)
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If dealer, make of car sold _____
Are you now operating a radiator dept.? ☐ Yes ☐ No

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Only BAR'S LEAKS

MOST WIDELY USED COOLING SYSTEM PROTECTIVE IN THE WORLD

is FINE enough to Flow through the newly designed Cooling System and Car Heater tubes (23/1000 to 70/1000 inch) in modern cars.

*BAR'S LEAKS designed with aluminum in mind

U. S. Patent 2580719
Canadian Patent 501547
Other Patents applied for

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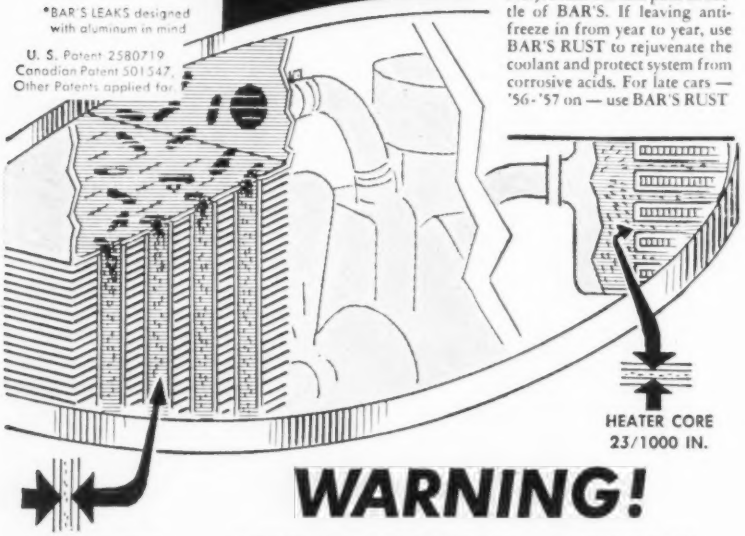
● For top engine performance, use BAR'S LEAKS or its affiliate, BAR'S RUST (same Pat. No.). Flush out and pour in bottle of BAR'S. If leaving anti-freeze in from year to year, use BAR'S RUST to rejuvenate the coolant and protect system from corrosive acids. For late cars — '56-'57 on — use BAR'S RUST



WARNING!

SERVICE STATIONS — DEALERS

Only BAR'S LEAKS meets the cooling system specifications of every automobile manufacturer as to fineness of ingredients and required protection.

Be on the alert! Many other sealer inhibitors contain coarse, bulky material. They clog the tiny new-car tubes of radiators and car heaters (23/1000 to 70/1000 inch). Fail to circulate. Fail to protect. As a result, aluminum components become pitted, harmful rust and scale develop, and seepage endangers vital metal parts. Remember, if you ruin a car, you're responsible.

Improved BAR'S LEAKS, now pelletized, dissolves to particles 15/1000 inch and smaller. BAR'S LEAKS circulates freely through the smallest heater and radiator cores. Only BAR'S LEAKS provides the required protection — inhibits rust and scale — seals all leaks in gaskets and porous metal. BAR'S is a *MUST!* Write for literature. Tells how you can qualify as a certified cooling system expert.

Cash in on BAR'S for a lucrative repeat business. LIST PRICE **$1.00**
Available through automotive jobbers, service stations, auto goods stores.

BAR'S PRODUCTS SUPPLY, INC.
(Office and Plant) P. O. BOX 146 • HOLLY, MICHIGAN

Check Voltage Regulator On Air Conditioned Cars

According to a recent Plymouth Service Bulletin, only a 30-ampere, low-speed cut in voltage regulator should be used on cars equipped with air conditioning. For this reason, the factory recommends that the ampere rating of the voltage regulator on their air conditioned equipped cars be checked at first opportunity — especially on cars built in Detroit.

If a car is not equipped with a 30-amp. voltage regulator, remove the unit and replace it with the recommended unit (Chrysler Part No. 1642333, Auto-Lite VRX 6201A).

Wheels Not Interchangeable

Because of the difference in design, shape and dimensions, the wheels and tires of the 1958 Chrysler Windsor model LC-1 are *not* interchangeable with previous model Windsor wheels nor any model of the Chrysler Saratoga or New Yorker models.

Therefore, under no circumstances should any attempt be made to install the 1958 Windsor LC-1 wheels onto the hubs of any other model.

According to the Chrysler Service Department, should such an attempt be made, it would result in the distortion of the brake drums caused by the interference of the improper wheels and would result in a very severe brake "chatter."

Pontiac Service Tips

The Pontiac factory reports that in a few of its 1958 models, the coil primary wire may be interfering with the throttle linkage. Possible results are holding the throttle plates open and fraying of the wire insulation causing ignition miss. To correct, the coil can be rotated in its housing, or the wire can be lengthened to provide clearance.

It is also reported that occasionally, part throttle surge may be encountered which can't be cured by ordinary adjustments. For this condition new step-up rods (part no. 7013366) have been released for service on Carter AFB Carburetors.

Drain Plug Eliminated on Rambler Differential

According to a recent factory service bulletin, the drain plug has been eliminated from the lower section of the differential housing on late model Rambler cars.

This change was made because regular drain and refill periods are not recommended for the rear axle. Serial numbers on the first cars to be changed are not available.

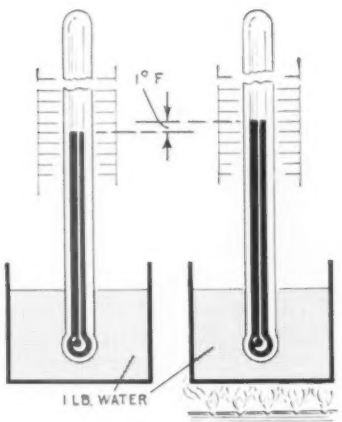
BRUSHING UP ON THOSE EASY-TO-FORGET THINGS

Refresher course

✔ *The meaning of B.t.u.*

• COMMON KNOWLEDGE tells us that it takes more heat to bring a kettleful of water to the boiling point than a cupful, in both instances with cold water at the same temperature. It is known that the quantity of heat required to produce a given rise of temperature is directly proportional to the amount of water heated. Also to increase the temperature of any given amount of water through, for example, 60 degrees, takes more heat than to raise the same amount through 30 degrees; just twice as much, in fact.

Hence, the heat required to raise the temperature of water is proportional to the amount of water and to the rise in temperature. Therefore, the unit of heat chosen is the quantity of heat needed to raise the temperature of a unit mass of water through 1 degree.



The heat required to raise the temperature of 1 lb. of water 1°F. is known as 1 B.t.u. (British thermal unit).

There are two units of heat in general use— the calorie (cal) and British thermal unit (B.t.u.). The calorie is the quantity of heat required to raise the temperature of 1 gm of water through 1 centigrade degree. The British thermal unit is the quantity of heat needed to raise the temp. of 1 lb. of water through 1 Fahrenheit degree.

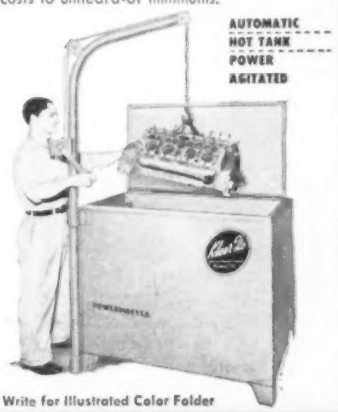
Example; to raise 5 kg. of water from 10°C. to 70°C. requires 5x1000x60=300,000 cal., and to raise 50 lbs. of water from 40°F. to 200°F. requires 50x160=8,000 B.t.u. There are 250 cal. in 1 B.t.u.

CLEAN PART-ners

CLEAN AUTOMOTIVE INDUSTRIAL PARTS 3 WAYS!
1. Continuous flow hose
2. Air Agitated soaking tank
3. "Super Power" Jet Air Gun

Klenzo SUPER CLEANMASTER MODEL 50
Klenzo POWERMASTER DEGREASER

Wash entire engine blocks or 200 pounds of smaller parts at once and fast! A unit that will definitely reduce your operating costs to unheard-of minimums.



Write for Illustrated Color Folder

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Oil Loss Through Crankcase Vent Pipe

To counteract customer complaints of oil loss out the crankcase ventilator pipe of Dodge W-1 and W-2 trucks operating in exceptionally hilly country, Dodge has released a special ventilator pipe (Part No. 1789582), made so as to form a trap for oil and prevent spillage. It is easily recognized by its shape—it resembles the number 7.

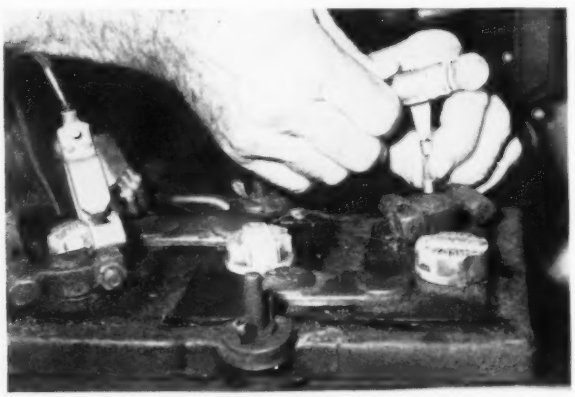
To install the new pipe, it is necessary to remove the rear valve spring cover wing head screw and replace with a hex head screw.

Always right—officially—customers are often wrong about car service. Next month's Business Know-How article deals with overcoming objections.

When Fuses Blow, There's A Reason . . . and It Will Pay You to Find It

● FUSES ARE USED in the automotive electrical circuits for just one reason—to keep the wiring from burning up due to excessive current flow . . . in other words, a blown fuse opens the circuit just as the opening of a switch would.

Some makes of cars have a fuse panel with all or most of the fuses together and clearly marked, which makes inspection and replacement simple. Other cars have the fuses in cartridges which must be opened up to expose



It's a good idea to test a new fuse before putting it in place . . . by using a test light hooked in series with fuse and car's battery.

the fuse. Others are in clips, located at various places under the dash, or at appliances or junction blocks. (In this connection, a car and truck fuse list which shows the proper fuse to use, and its location, can be had by writing to the Bussmann Mfg. Co., 2536 W. University St., St. Louis 7, Mo., or from their distributors.)

When replacing fuses, always put in a fuse of the same size that was burned out. Since capacities correspond to length, it is more difficult to put in a wrong fuse than it is to put in the correct one. In a pinch, however, where no other fuse is available at the time, the next size larger can be used, but the contact surface will be reduced.

DON'T USE A JUMPER

Never jump a fuse with wire or tin foil. When a fuse blows it is because the circuit is carrying more current than it should due to a short or extremely high voltage. By jumping the fuse there is every possibility that the circuit will burn out at some other point with very unpleasant results.

Excessive current will burn out the weakest spot in the circuit, but it often gets fairly long lengths of wire hot enough to set the insulation on fire before the weakest spot lets go.

All fuses must be capable of carrying their rated current capacity continuously without overheating, and are designed to blow at 125% of rated capacity within one hour and within 25 seconds at 200% of rated load.

TEST ALL NEW FUSES

Whenever a new fuse is needed, it is a good idea to test it *before* putting it in place, because a new fuse may often look perfectly good and still not pass current due to poor contact of the inner fuse wire with the caps. A quick check of the fuse can be made by using a test light with the fuse hooked in series with the light and a charged battery.

When fuses blow repeatedly, and the location of the short or ground causing the trouble is not easily located, a safe way of finding it is by using a battery-starter tester with a built-in carbon rheostat. Jump the fuse with a piece of wire, then open the battery circuit at either battery post and insert the rheostat on the battery-starter tester. Turn on the current and increase it to a little over twice the rating of the blown fuse. This will gradually heat up the wire in the circuit where the trouble is located so it can be felt or smelled as the insulation heats up. The limited current will not do any damage, such as would be caused if full battery current were allowed to flow into the circuit.

For Proper Clutch Pedal Operation Check Overcenter Spring Adjustment

According to a recent Plymouth Service Bulletin, overcenter spring adjustment on cars equipped with manual transmissions is very important to insure correct clutch pedal operation.

When adjusting an overcenter spring, the factory recommends disconnecting the clutch pedal rod at the upper end by removing the spring clip from the pedal rod stud. Then move clutch pedal to the floor position, loosen the overcenter spring adjusting nut with a wrench until it is free, then tighten finger tight. After this is done, tighten the adjusting nut (against the spring bracket) five complete turns for 6-cylinder cars and seven complete turns for 8-cylinder cars. Reinstall clutch pedal rod and clip, then check pedal action.

If heavier pedal action is desired, loosen the nut one turn; if lighter action is desired, tighten the nut one turn.

Grips the screw!
Drives it too!
Quick-Wedge
SCREW-HOLDING
SCREWDRIVER
2" to 14" blades. 4 bit sizes. Available with shockproof plastic covered tubing. Unconditionally guaranteed.
ASK FOR IT AT YOUR DEALER
Kedman Co., 233 S. 5th W., Salt Lake City

"I'll see your suspension chassis and raise you two valve-in-head engines!"

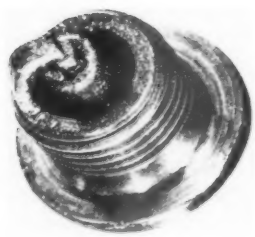
Condition of Spark Plugs Can Give Helpful Clue As to What's Wrong

When replacing the spark plugs in your customers' cars, be sure to take the time to examine the old plugs carefully—occasionally they can give you helpful clues as to whether or not any engine malfunction exists.

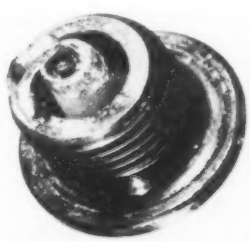
To help diagnose some of the common plug conditions

Normal Condition—Insulator is light tan or brown, and light combustion deposits may be sticking to the insulator and shell bore. Electrode erosion will be about .001 inch or less per thousand miles.

Carbon Fouling — Dry, fluffy soot on electrodes and insulator, generally a result of over-rich mixture.



Oil Fouling—Oily black deposits on electrodes and insulator, usually caused by incorrect heat range and or excessive oil getting past piston rings or valve guides.



Burning — Whitish appearance of insulator and electrodes which show evidence of severe burning. Usual cause is incorrect heat range or excessively high combustion chamber temperatures.

encountered, the Champion Spark Plug Co. submits the accompanying illustrations with the reminder that most so-called "plug trouble" is *not* caused by the spark plug at all.

Of course, it is most essential that plugs of the correct type and heat range be installed to fit the type of driving usually done by the car owner; that is, stop-and-go city driving, or high-speed, over-the-road operation.

By combining a careful spark plug analysis with a diagnosis of engine ailments, over-all performance can be improved considerably.

Check Position of Manual Valve When Disassembling Powerglide

Improper Powerglide disassembly procedure can cause a bent manual valve and manual valve inner lever. To prevent this, the manual valve should be moved into the position that places it as far as possible into its bore. On 1958 models, this means placing the manual selector lever in "Low" before separating the two case sections. On past models, the proper position is "Reverse."

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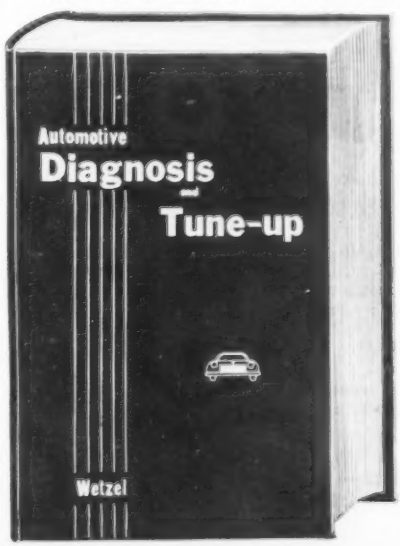

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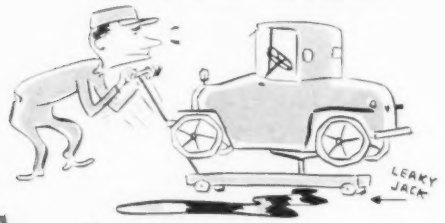

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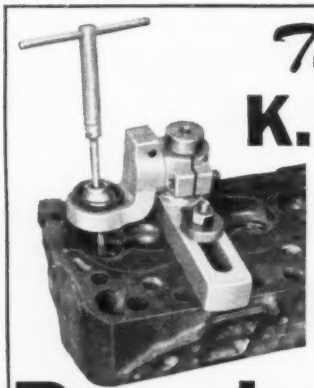

The New

K. O. Lee Valve Guide Reaming Sets

Designed to service late model engines which have valve guides cast as part of the cylinder head. In this new type head, it is the valve which has to be replaced. This is accomplished by reaming out the valve guide for oversize stem valves. Most of the engine and valve manufacturers now offer at least three sizes of oversize valves.

The Lee Reamer Guide provides a true alignment with original guide bore using Lee Self-expanding pilots. The reamer is held rigid with reaming bushing during reaming operation. Simple to operate and extremely accurate.

Special sets available to service Ford, Mercury, Lincoln, Chevrolet, Plymouth, Dodge, DeSoto, Chrysler.

R55 Reseater Power Drive adapts to these valve guide reaming sets.

Clip ad to your letterhead and send for Literature.

K. O. Lee Company, Aberdeen, S. D.

Pontiac's Wheels and Tires Electronically Balanced at Factory

Pontiac technician demonstrates new electronic device now being used by Pontiac Motor Division to balance wheels and tires. The electronic unit is so sensitive that a burnt match placed on a wheel and tire being balanced will change the weight adjustments needed to balance the two. The precise spot where the weight is to be located is marked in paint by the machine and indicates the exact amount needed for perfect balancing. Shown in the insert is the heart of the system.

Failure to Adjust Antenna Compensator Often Cause of Poor Car Radio Reception

Unsatisfactory operation of car radios, such as weak reception, volume fading, poor touch-tuner station selection, etc., is frequently caused by failure to adjust the Antenna Compensator (trimmer). A great deal of owner dissatisfaction can be avoided by making sure that this important service operation is not overlooked.

In most cases this adjustment is made by extending the antenna fully and manually tuning the radio to a weak station (around 1000 kilocycles). Turn the antenna trimmer adjusting screw until maximum volume is attained.

"Oh, just killing time. What are you doing?"

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HE WHO LAUGHS, COME WHAT MAY,

WILL LIVE TO LAUGH ANOTHER DAY

Short circuit smiles

Parson Webster phoned the local board of health to ask that a dead mule be removed from in front of his house.

The young clerk who answered thought he'd be smart.

"I thought you ministers took care of the dead," he remarked.

"We do," answered the parson, "but first we get in touch with their relatives."

★ ★ ★

"For months," said the gadabout, "I couldn't discover where my husband spent his evenings."

"And then what happened?" breathlessly asked her friend.

"Well," she answered, "one evening I went home and there he was."

★ ★ ★

The lovely young Miss had just accepted a proposal, and her fiance sat in deep study. When she asked, "Sweetheart, why don't you say something?" he sadly replied, "I've already said too much."

★ ★ ★

"I tell you I won't take this room," protested the old woman to the bellboy. "I'm not going to pay good money for a room like this. It's too small and it hasn't got a window. Just because I'm from the country. . . ."

"Get in, lady, get in," sighed the bellboy. "This is the elevator."

★ ★ ★

"No, let's don't play Post Office," said Lulu. "Let's play Building and Loan."

"How's it go?" asked Luke.

"You leave the building and let me alone!" retorted Lulu.

★ ★ ★

No matter how poor a man is at mathematics, he knows that 36, 25 and 36 add up to a nice figure.

Englishman No. 1: Sorry to hear you buried your wife old chap.

Englishman No. 2: Had to—dead you know.

★ ★ ★

A university professor, rather old and absent-minded, was awakened by the telephone at 2:00 a.m. Inquired the caller: "Is this one, one, one one?"

"No," yawned the sleepy professor, "it's eleven, eleven."

"Pardon me," said the caller, "I have the wrong number. Sorry I disturbed you."

"That's all right," muttered the professor, "I had to get up to answer the telephone anyway."

★ ★ ★

"And if you miss one single alimony payment," threatened the divorcee to her ex-husband, "I'll repossess you!"

★ ★ ★

It is better to trust your fellowmen and be occasionally deceived than to be distrustful and live alone!

"Now try and remember all the little things that annoy you about your car . . ."

Two celebrants registered at a hotel and asked for twin beds. In the darkness and confusion they both got into the same bed.

"Hey," yelled the first drunk, "They gypped me. There's another guy in my bed."

"There's somebody in my bed, too," said the second drunk. "Let's throw them out."

There was a terrific struggle and finally one drunk went sailing out of bed.

"I threw mine out," the one in the bed yelled. "How about you?"

"He threw me out!"

"Well, that makes us even," whispered the first drunk. "Keep quiet and get in bed with me."

★ ★ ★

The five-year-old visiting a young couple with a new baby, gazed at the small, red, wrinkled face for a long time, and then said solemnly, "So *that's* why she hid him under her coat for so long!"

★ ★ ★

We've just heard about a chap who celebrated New Year's Eve so well he woke up next day in the hospital. "Good grief," he moaned as he recognized a friend at his bedside. "What happened?"

"Well, I'm afraid you had quite a load on last night. You went to the Smith's window, stepped up on the sill and announced you were going to fly over Manhattan."

"Wh-a-a-a-t!" cried the injured man. "And you didn't stop me?"

"Well, to be perfectly frank," admitted his friend, "last night I really thought you could do it."

★ ★ ★

In hiring an entertainer, a Soviet radio executive said, "Boris, you're a wonderful comedian. We're giving you a lifetime contract."

"That's most kind of you," Boris replied, "but what if I turn sour?"

"In that case," retorted the announcer, "we'll honor the contract but shorten your life."

★ ★ ★

The sweet young thing rushed into the eye, ear, nose and throat specialist and waved her broken glasses at him.

"I just sat on these," she explained. "Will I have to be examined all over?"

"No," replied the doctor, "just your eyes."

★ ★ ★

Johnny: "What is the first thing you notice about a girl?"

Jack: "It depends on which way she's going."

★ ★ ★

The draft board doctor was examining a prospective recruit.

"Read the chart over there," he commanded.

"What chart?" asked the draftee.

"That's right," said the doctor, "there isn't any chart. You're in, boy."

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